PHYSICAL EXAMINATION
IN HEALTH AND
DISEASE

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RUDOLPH H. KAMPMEIER, A.B., M.D.

PROFESSOR OF MEDICINE, VANDERBILT UNIVERSITY SCHOOL OF MEDICINE
VISITING PHYSICIAN TO VANDERBILT UNIVERSITY HOSPITAL; CHIEF OF THE
MEDICAL OUTPATIENT SERVICE, VANDERBILT UNIVERSITY HOSPITAL
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DEDICATED

TO MY WIFE,

BLANCHE

FOREWORD

THE BEST CLINICIANS I know are also the ablest in physical diagnosis Certainly it is very unusual to see an able physician who is not adept in physical diagnosis Dr Kampmeier strives in his course at Vanderbilt to prepare a solid foundation for continuous development in this art for he too believes that upon such a foundation rests much of the diagnostic skill of the experienced clinician

This book was written to aid the student I believe that it will

HUGH J MORGAN M D

PREFACE TO THE SECOND EDITION

AFTER SEVERAL REPRINTS the time has arrived for a second edition This indicates that as a textbook the PHYSICAL EXAMINATION IN HEALTH AND DISEASE has been successful The doubts regarding the need for another text on physical diagnosis have been allayed for me and for my friends who shared these doubts with me

The need for new editions is not as urgent in time for textbooks in physical diagnosis as for books dealing with new advances in laboratory medicine or in therapeutics Yet nothing is so static in medicine that changes are not needed even in relatively well stabilized subjects Changes in emphasis may be in order as well as the additions of new information in the field

In general the plan of presenting material in this book —as the normal and its variations to be followed by a section or chapter on the abnormal has been accepted by the teachers using the book with acquiescence to outright enthusiasm Here and there has been a dissenting voice especially with respect to one item This is the lack of a chapter on the nervous system and its variations in disease An explanation of this apparent deficiency may be in order

My aim in this textbook for second year medical students is to set the pattern for life long practices in the study of the patient I hope to form habits for the general practitioner internist or pediatrician as I must at this stage of the student s training and not for the specialist Thus the examination should be carried out in an orderly way by the one examining doctor not for the moment an ophthalmologist an otolaryngologist a neurologist or other specialist The intricacies of the nervous system tend all too often to turn the doctor from a neurological examination as something over his head Is it not better then to include the neurologic findings of the eyes and cranial nerves under the head to be examined along with other structures of the head rather than as a separate examination described at the end of the

occupies the major portion of the student s time in the third trimester of the second year at Vanderbilt University School of Medicine Thus they have a stake of interest in this text which is more than casual

Dr Edgar Hull Professor of Medicine at Louisiana State University School of Medicine because of years of friendship gave many hours to a critical review of the book His years as a teacher and a clinician provide the background for valuable suggestions and criticisms

It is my hope that the changes made in the second edition will enhance the teaching value of this textbook still more to those teachers who have found the first edition a helpful aid

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book This applies to the examination of the extremities also If the neurologic examination is part and parcel of the general physical examination it will be done with more frequency than if set off as a separate entity Lastly, practical considerations prompt me to educate the undergraduate student to do a comprehensive examination in the shortest time possible This consideration requires that the examination of an anatomic part be completed as the examiner moves to another Only thus do I hope the busy practitioner will be attracted by the Argyll Robertson pupil for example in the patient having only abdominal pain The exigencies of practice might cause the harassed practitioner to forego a neurologic examination because of the apparent localization of the clinical events to the abdomen

In this revision new material is introduced in certain areas, changes are made to clarify questionable statements and the inevitable errors which creep into any first edition are I hope corrected Changes had been made here and there as reprints appeared, limited however by pagination

I wish to extend the acknowledgments made in the first edition Additional aid has been given by my confreres in preparing this edition Dr R N Buchanan, Associate Professor of Clinical Dermatology and Dr W G Kennon Jr Assistant Professor of Clinical Otolaryngology have kindly reviewed the material in their respective fields The statements made relative to the neurologic examination and the findings in disease in the first edition have been carefully reviewed by Dr B E Sprofkin Assistant Professor of Neurology Clarification of statements relative to the nervous system which was needed has thus been made possible by his liberal contribution of time Dr James A Kirtley Jr Associate Professor of Clinical Surgery reviewed the material related to examination of the blood vessels of the lower extremities Dr Lloyd Ramsey Assistant Professor of Medicine in his interest in pulmonary physiology has made contributions on the chest

Again I must extend thanks to those whose aid was acknowledged in the first edition and especially to Dr David Strayhorn who has continued to keep the chapters on the heart under surveillance With few exceptions all those whom I have mentioned take an active part in the integrated course of Introduction to Clinical Medicine which

PREFACE TO THE FIRST EDITION

UPON LEARNING THAT I was preparing a manuscript for a text book on physical diagnosis several of my close friends more or less seriously asked What excuse is there for another text on the subject? I had already asked myself that question before undertaking the arduous task of writing this book

There are several excellent textbooks on physical diagnosis designed for the undergraduate student My objective is also the teaching of the fundamentals of the physical examination to the medical student In more than twenty years of teaching this subject and clinical medicine I have used the textbooks alluded to above There are several features in these books which I have felt could be modified with benefit

The medical student enters the third year with an inadequate knowledge of medical terminology Therefore many different technical terms and synonyms have been utilized in this book to assist in broadening the student s medical vocabulary

One modification which I have tried to introduce into this book has been to give the reason—anatomic physiologic or pathologic—for physical manifestations when the cause is not obvious This has been done in an effort to answer the eternal question I have met for years in the practical exercises in the course on physical diagnosis This question has been Why?

In other current textbooks it has been customary to intermingle methods of examination normal findings and abnormal findings in the same chapter I believe this has at times confused the student and that normal findings have not been duly impressed upon him In this book therefore I have divided the presentation of the physical examination as related to various portions of the body as follows In general two chapters are devoted to each region The first of these chapters presents the technic of examination and a description

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of the normal and its variations This is followed by a chapter describing the abnormal findings which may be encountered

In the chapters describing the abnormal findings, especially those of the heart and lungs, an effort has been made to relate these to pathologic changes Surely, if the student can recall the changes seen in lobar pneumonia as demonstrated at the autopsy table the physical findings should be more easily understood

A book whose subject matter deals with training the novice in objective technics needs illustrative material Many illustrations have been used They have been selected to amplify textual descriptions Although most of the cuts portray common conditions, rare ones are illustrated also if it appeared to me that a striking picture would be remembered more certainly than a description in words

As I was a student before the use of the roentgen ray became as widespread as it is today I learned well the fundamentals of physical diagnosis and still insist upon their importance One must neverthe less not be reactionary and thus I have tried to correlate the findings of the physical examination with those of the x ray examination I have depended little upon line drawings to illustrate pulmonary infiltration, let us say but rather have used x ray films showing characteristic examples of the condition After all in the practice of modern medicine, the physician integrates the results of his physical examination with those obtained by other technics

In other textbooks on physical diagnosis it has been customary to illustrate examples of advanced disease Thus the illustrations of carcinoma of the lip or breast have shown extensive disease with much tissue destruction I have felt it wiser to show small apparently innocuous lesions as illustrations of malignant disease The object *is to have the student associate carcinoma with early minimal changes* and not with advanced lesions which any lay person may diagnose

Finally, I repeat that this book is for the person who is interested in the fundamentals of the physical examination At the end of the chapters devoted to abnormalities of the chest the heart and the abdomen are sections designed to bring together the isolated abnormal findings, to constitute more or less complete patterns on diseases preceded in each instance by a brief description of the pertinent lesion This textbook however makes no pretense of attempting to

be a treatise on *medical diagnosis* Although some teachers may use these in courses on physical diagnosis I do not They may be excellent for the upper classman intern or physician but they offer more than the second year student can digest Furthermore they go so far afield into clinical medicine that the beginner has his attention diverted from the task at hand

RUDOLPH H KAMPMEIER M D

ACKNOWLEDGMENTS

THE AUTHOR WISHES to acknowledge the assistance and suggestions given him by various members of the faculty and others of Vanderbilt University School of Medicine

The writing of this book would not have been undertaken except at the insistence of Dr Hugh J Morgan Professor of Medicine and Head of the Department To Dr Edgar Jones Associate Professor of Clinical Medicine go my thanks for the many hours he spent in editing and checking a large portion of the manuscript as well as for many suggestions

A will be noted in the table of contents Chapter 2 'The Body in Action was written by Dr William F Orr Professor of Psychiatry and Associate Professor of Neurology He uses the approach of presenting the functions of the nervous system in health and its deviations in disease in terms of the role which it plays in total bodily activity

Several others of the faculty gave generously of their time Dr Albert Weinstein Associate Professor of Clinical Medicine reviewed the material having to do with endocrinology in Chapters 3 and 4 Dr David Strayhorn Associate Professor of Clinical Medicine read and checked the chapters covering the heart and blood vessels Chapters 10 and 11 discussions on the examination of the chest in health and disease were read and criticized by Dr Herbert C Francis Professor of Radiology and Dr Rollin A Daniel Jr Associate Professor of Surgery The latter also made valuable suggestions relative to Chapter 9 on examination of the breast

The portions of Chapters 5 and 6 having to do with examination of the eyes were reviewed and criticized by Dr Henry Carroll Smith Professor of Clinical Ophthalmology and Dr Allen Lawrence Assistant in Clinical Ophthalmology Dr Edwin L Williams Instructor in Obstetrics and Gynecology passed upon the portion of the manuscript dealing with examination of the female genitalia and cooperated in obtaining photographs demonstrating the technic of the examination

Thanks are due Dr Granville W Hudson, Assistant Professor of Radiology, for the selection of certain roentgenologic material and the reproduction of the first angiocardiograms made at Vanderbilt University Hospital Dr Robert H Furman Resident in the Department of Medicine, was most cooperative in selecting patients for and in recording the stethograms, as well as for some of the electrocardiograms reproduced in the text Dr Richard O Cannon Instructor in Obstetrics and Gynecology, and Dr Leonard J Koenig Instructor in Pediatrics were kind enough to select several patients from their clinic for photographs

For permission to use photographs I wish to thank Dr Ernest W Goodpasture Professor of Pathology, Dr Barney Brooks Professor of Surgery, Dr Amos Christie Professor of Pediatrics, and Dr John C Burch Professor of Obstetrics and Gynecology

The author wishes to express his appreciation to Miss Susan H Wilkes, Artist of the School of Medicine for her cooperation and valuable suggestions in the assembly of the illustrative material so essential to a book of this type So also, I wish to thank Mr Claude W Rye formerly photographer in the Department of Illustration, for the many hours spent in making prints in reproducing x ray films, and in photographing technics of examination

Last but not least I wish to express my gratitude to Mrs Marie Hall my secretary, who typed the manuscript and assisted in the many details involved in the preparation and assembly of the material for this book

RUDOLPH H KAMPMEIER M D

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CONTENTS

PHYSICAL EXAMINATION IN HEALTH AND DISEASE

INTRODUCTION

To cure sometimes
To relieve often
To comfort always

THIS QUOTATION APPEARS on the statue erected to the honor of Francis Trudeau at Saranac Lake physician and comforter to many patients suffering from tuberculosis These few words describe the physician s function in his practice of medicine To carry out these objectives the doctor should know in so far as possible the source of the illness which has stricken the patient and in which organs of the body it has caused pathologic changes He must have arrived at some such conclusion—all too often incorrect unfortunately even in the best of minds—before he can institute a rational regimen of treatment

The information that is needed before attempts can be made to cure or to alleviate the illness is to be gained only by a history of the illness and examination of the patient first by routine physical examination then possibly by special methods or technics and by laboratory studies which may seem to be indicated The importance of these vary in a given case

In accidents or acute disturbances the history may be *very brief and* an examination may make the diagnosis at once For example, if a person falls and injures his arm the pertinent history may be contained in a few words the physician may in moments diagnose a fracture of the radius and ulna If he cannot be certain of a fracture because of the absence of deformity he may need to employ an x ray examination The person with a furuncle (boil) of two days duration comes to the doctor able to give no history other than of its appearance and a glance in the examination makes the diagnosis The alert physician knowing of the tendency to skin infection in diabetes mellitus will satisfy himself by a history and urinalysis as well as by examination that the patient does not have this disease

In more chronic diseases the history is more often than not the

major key to diagnosis History taking is an art that all too few physicians master, because of either mental laziness or the threadbare excuse of being 'too busy to spend the needed time (I question whether one can afford ever to be too busy to obtain the essential history in selected cases) Such a lazy physician casts about for any diagnostic straws that may be offered by the laboratory, x ray, or other studies in arriving at a diagnosis

Obviously, in psychologic disturbances, as in the psychoneuroses, and in certain psychoses, the only diagnostic method is that of the history But this is true also in certain symptom diseases that may be serious, as in tic douloureux, or even fatal, as in angina pectoris

In chronic disease of organic origin, the history may point the road toward the etiology and pathogenesis, whether of infectious, metabolic nutritional, degenerative, or malignant origin The history and physical examination will determine the other diagnostic methods to be employed Thus the symptomatology and the findings of pulmonary disease may demand the use of the x ray in carrying the examination further but this may be inconclusive, and on the basis of the history bronchoscopic investigation may be indicated in a given case Commonly, in a patient having symptoms related to the gastrointestinal tract it is the history which prompts the physician in his choice of whether to use barium by mouth or by enema for x ray study, whether to examine the gallbladder by x ray or to do liver function tests, or whether to have a stool examination for amebas or to pass a sigmoidoscope

Irrespective of how many diagnostic aids the physician has at hand, he must still use history taking and examination The more skilled he is in these two fundamental approaches, the more pointed is his employment of diagnostic aids and special methods of examination and thus the more brilliant will be his diagnoses and employment of therapeutic measures If the student will evaluate carefully the methods used by those of his clinical instructors with apparently the best diagnostic acumen he will find in each instance one who has mastered the art of asking questions of the patient and one who makes keen observations regarding the patient At times it appears to the novice as if the clinician arrives at conclusions too quickly so that he might even be accused of making a snap judgment implying one

without foundation or fact This is not necessarily so since it may represent accurate observations and their interpretation based upon a foundation of a broad clinical experience gained over the years

The individual physician builds up in his experience in years of practice much information upon which he relies in his diagnosis and treatment of disease But we must not forget that he begins this superstructure upon a foundation which he obtained in medical school This foundation is an accumulation of knowledge *amassed in the past* centuries History taking and physical examination have been applied no doubt since man was capable of recognizing that other members of the family or tribe were unwell irrespective of what his interpretation of these facts might be Certainly even in the most ancient of writings descriptions appear often dramatic of sickness and of abnormalities of the body The deformities illustrated in ancient sculptures pictographs and pottery figurines dating from early cultures of the Mediterranean region and Far East to those of the Central and South American Indians indicate a careful observation of anatomical abnormalities

The descriptions of many diseases dating back to the centuries before the Christian era are in many instances so accurate that little has been added since then Since this is not a treatise on medical history this background of physical diagnosis cannot be recounted though it is most tempting to do so Rather must I hope to stimulate an interest in medical history by a few examples of events and observations here and there and to give the student some idea of how modern medicine has reached its high level

Many clinical notes or observations are ascribed to Hippocrates who lived about 500 B C Mumps including the complication of orchitis is said to have been described by him Leprosy and tuberculosis were quite adequately depicted by the old Greek physicians In the first century A D Aretaeus left a description of his observations in lobar pneumonia that leaves little to be added exclusive of auscultation of the chest He also recognized the symptoms and signs of diabetes mellitus (a melting down of the flesh and limbs into urine) though the sweetness of the urine was not realized *until* the seventeenth century by Willis In the second century A D Galen described smallpox and contributed many other observations from his experience

in medicine Aetius recognized paralysis of the soft palate as it may occur in diphtheria

During the Dark Ages, the accumulation of medical knowledge was retarded being contributed to mainly by the Arabic culture, Rhazes an Arab physician described several diseases very well in the ninth and tenth centuries Thereafter century after century showed an ever increasing knowledge of disease with more and more careful study in history taking and bedside observation In the sixteenth century syphilis in its many manifestations was quite well described and recognized The differentiation of smallpox from chickenpox was noted in this century by Ingrassia, who also found scarlet fever to be an entity The seventeenth century saw the description of rickets by Glisson and of bronchial asthma by Floyer Pellagra was well pictured by Cazal in 1762, and Ballonius wrote of the clinical recognition of diphtheria of the larynx and trachea in 1782

No doubt the observations made for centuries by physicians upon their patients were mainly those of inspection and palpation Leopold Auenbrugger a Viennese physician discovered the value of percussion and described it in a treatise in Latin Inventum Novum in 1761 *Its value remained unrecognized until Corvisart physician to* Napoleon, translated it into French in 1808

The nineteenth century saw the beginning of an increasing momentum in medical progress It was the era of intensive study at the autopsy table and of careful and detailed descriptions of gross pathology by such masters as Virchow This knowledge stimulated more careful study at the bedside so that correlations could be made between the clinical manifestations of disease and of anatomic changes This century is studded with well known names of men who described disease entities on the basis of historical and clinical observations The names of Gull Graves Parry Basedow, and Kocher are associated with diseases of the thyroid gland Bostock wrote an excellent description of hay fever in 1819 The names of Addison and Hodgkins are readily recognized as associated with clinical descriptions of disease

One of the most far reaching treatises ever published *having to* do with study of disease was that of *Traite d Auscultation Mediate* by Rene Laennec in 1819 This was the description of the stethoscope and its application in the study of disease of the lungs This instru

ment is still the sole means of establishing many clinical diagnoses Later in the nineteenth century Ludwig von Helmholtz developed the ophthalmoscope a most valuable instrument of diagnosis not only to the ophthalmologist but also for the physician in his routine physical examination giving him an instrument with which to learn much about the blood vessels and central nervous system

Since the beginning of the present century the major developments in diagnosis have been those of special aids and of laboratory methods The x ray technic dating from the turn of the century, the electro cardiograph and the biochemical hematologic and other laboratory procedures play an ever expanding role

The medical student and the physician in their study of the sick are carrying on in the best tradition of all the great physicians of the past two thousand years and more By their careful clinical observations these physicians of the past have provided a knowledge of disease that is the medical student s heritage at the time of his graduation He is asked to apply the same principles of painstaking study of the ill person that were used by those great clinicians of the past who have built this heritage Only by this means can the medical student become an adequate physician I emphasize this most strongly since all too often the medical student is dazzled by the apparent exact science of the clinical laboratory and aids like the x ray and the electrocardiograph Only rarely can the diagnosis of disease be made by taking a blood sample to the laboratory without regard to the clinical status of the patient And even in these rare instances the prognosis and the treatment of the patient depend more upon the clinical observations than upon the laboratory or other special diag nostic aid

Finally the author joins all those teachers who devote time to laying the groundwork for the clinical study of patients in the hope that it will be but the beginning of attentive observation of the patient a hope that neither mental sluggishness nor disinterest will deter the physi cian from developing ever more keenness with the passage of years in the study of the patients in his care For there can be only pity for those patients who fall into the hands of the doctor who ceased being a student upon the date of his graduation from the medical school

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1. THE CASE HISTORY

AS WAS INDICATED in the Introduction the taking of a history is an art all too frequently never mastered by many medical students and practitioners of medicine Yet I must emphasize again that it is the application of this art which leads to the more or less scientific examination of the patient It is only after an adequate history and physical examination that the physician is able to decide upon the necessity of and the choice of more highly scientific adjuncts for diagnosis from the laboratory viewpoint

History taking is one of the important, if not the most important, teaching and educational means in the acquisition of knowledge of clinical medicine It is only by the taking of many histories that the student or young physician acquaints himself with the composite picture of a given disease To be sure it is described in his textbook but it is universally agreed that book knowledge not only is a poor second to firsthand knowledge but also makes a less lasting and less deep impression The fascination of eliciting the facts of disease at the bedside often leaves them so imprinted on the mind as never to be forgotten Therefore it is in his days as a ward clerk and an intern that the young physician learns the syndromes of disease He also learns what pertinent questions should be put in order to save time and yet be adequate in history taking in his later and busier days in practice It is for this reason that I have only one answer for the medical student who wishes a shortcut in history taking namely that *he must write a detailed history!* There is no easy or superficial method of learning the fundamental facts about disease Only methodical study can give this knowledge It is by careful interviews at the bedside that etiologic factors anatomic changes physiologic disturbances functional abnormalities and the natural course of disease will be learned and understood

The hardest conviction to get into the mind of a beginner is that the education upon which he is engaged is not a college course not a medical course but a life course for which the work of a few years under teachers is but a preparation

—SIR WILLIAM OSLER

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associates to do their history taking (To be sure many themselves check the history thus obtained) Nevertheless one may set up an ironclad rule *No one is able to take an adequate history for another person* Obviously if a younger associate cannot provide an adequate history a history taken by an office nurse is worse than useless She can at best merely ask a routine set of questions and set down the answers More will be said later about routine history outlines

The experienced and good clinician knows well the symptoms signs and differential diagnosis of many diseases He himself must get the relevant facts for he must weigh their importance and evaluate them as to their organic or psychogenic origin He must pick facts from fallacies to substantiate a diagnosis

TECHNIC OF HISTORY TAKING

Attitudes The reason that the taking of a history is more than recording the answers to a set of questions is that it must represent the first step in the development of rapport between doctor and patient The doctor by his interest must induce the patient to be willing to reveal eventually even the most intimate details relative to his or her illness Therefore even in the introduction of himself to the patient the doctor should show all that is implied in good manners courtesy and tact

There must be at least apparent leisure in the history taking If the patient is hurried along by impatience on the physician s part he *may not* give a complete history believing that his doctor is not interested A cooperative patient then requires that he be given the opportunity to tell his story without the disturbance of a series of rapid questions and the scratch of the pen By tact the doctor controls the history taking by a pertinent question he leads back the patient who has wandered from the subject

The historian must be patient and sympathetic and above all he must never lose his composure or temper The patient is ill and therefore he may be querulous impatient of questioning and all in all very unpleasant It actually may be quite trying in some instances for the physician to remain calm but it is essential for his rapport with the patient that he do so It is especially difficult to be greeted

What of the practitioner who all too often is heard to remark in effect (and at times unfortunately he makes these statements to individual medical students) It is all well and good to speak of history taking in hospital practice, but in a busy practice there isn t time ' Such comments are merely an excuse for mental laziness or a complete lack of interest in medicine and such a doctor practices a "stick-out your tongue here a prescription type of medicine

The facts are the following (1) As was indicated in the preceding paragraph if the physician has learned the art of history taking he can reduce the detail to a great degree and to relative brevity A brief, good history is the product of basic training in this subject and a great background of comprehensive case taking (2) The general practitioner has relatively few complete histories to take Much of his day is spent in seeing or calling upon patients who have been his patients for months or years, thus, these represent return visits after an original history and examination In a general practice in a small community there may be need for only one or two new histories per week Furthermore, many patients require practically no history The man who comes into the general practitioner s office to have a splinter removed from his thumb needs a history of only a dozen words if casual questioning reveals no other complaints (3) The more careful and detailed histories usually will be needed in diseases of more chronic nature Since no emergency is entailed the patient may be asked to return at a time more convenient for leisurely history taking Such a plan can be carried out successfully The author knows this not only from observing the practices of others but also from his own experience far removed from a medical school in which he reserved the last hour of the forenoon after home hospital and brief office visits for the complete case study of new patients When the patient learns that a more adequate evaluation of his complaints can be made by such a scheme he is very happy to wait until another day

If the student has the opportunity to observe the consultant at work, he will find that such a physician will not proceed without what he considers to be an adequate history (This fact obviously answers any scoffing remarks the occasional general practitioner makes concerning history taking) However I cannot pass the consultant by without decrying the tendency of some busy consultants to employ younger

associates to do their history taking (To be sure many themselves check the history thus obtained) Nevertheless, one may set up an ironclad rule *No one is able to take an adequate history for another person* Obviously if a younger associate cannot provide an adequate history a history taken by an office nurse is worse than useless She can at best merely ask a routine set of questions and set down the answers More will be said later about routine history outlines

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by a statement in essence "I ain t goin to tell you a thing I came for you to find out what s the matter with me" A sense of humor only can get the physician over this type of hurdle

The physician must never express surprise or shock at anything the patient may reveal To do so may cause an immediate psychologic block and the patient may well withhold intimate and yet possibly most important information A physician must never be an arbiter of morals but merely a recorder and observer of biologic, physiologic and psychologic facts In this connection, it may be well to point out that in portions of the history (as will appear below) it is best not to set down on paper all that the patient reveals at least at the moment He may hesitate in his revelations if he is faced with their visible recording It may be better to listen and to write later

Careful observation of the patient during history taking offers many clues to his fears and hopes Human beings are so constituted that reactions to disease and anxiety vary greatly The patient with cancerphobia may dwell at length upon certain symptoms he may suspect to be important in this respect Exaggeration because of anxiety thus may lead to a warped and misleading history On the other hand one suspecting he has a carcinoma yet fearing the diagnosis may make light of or skip over certain symptoms giving an equally misleading history The keen historian will note these tendencies and confirm his suspicions by adroit questioning This illustrates why we speak of history taking as an 'art and emphasizes why no other person can substitute in this procedure for the physician responsible for the diagnosis and management of the patient The diagnoses of psychoneurosis and psychosis are made purely and only upon the history the diagnosis unfolds as the experienced physician listens to the story If hesitancy or embarrassment appears or evidences of emotion such as blushing tears or tremulousness of the voice it is obvious that this portion of the history is of extreme importance in the last analysis insofar as it touches the patient s emotional life It may be best at this first visit to make mental note of this reaction and again approach the subject at a later visit By that time history physical examination and some laboratory studies may have been completed A patient will then be less likely to object to probing of the psyche in the evaluation of a somatic complaint Such might seem far afield to

the patient upon his first visit especially before an examination is made

The Vernacular One of the earliest technics the medical student must learn is to use the vernacular Human beings dislike to admit their ignorance and will avoid doing so by answering questions as if they understood them For example one day in the clinic I over heard a fourth year student ask a colored laborer Have you ever had a chancre on your penis? The answer was No suh no suh Later upon examining the patient with the student, I asked When did you have a haircut on your privates? A positive answer was forthcoming It seemed quite apparent that this patient neither knew nor could be expected to know what the terms chancre" or penis meant The novice must know that even highly educated persons have a limited medical vocabulary Loose terms such as ' indiges tion rheumatism ' or neuralgia will mean more to them than more specific nomenclature

Use of Outlines Outlines for history taking are helpful to the beginner but should be dispensed with in the fourth year in medical school It is obvious that the beginner in clinical medicine is at a loss concerning the questions to be put to the sick person to amplify his story Of course the expansion of the fund of questions to be used in selected cases never ceases in a physician s experience As medical knowledge expands and new disease entities are recognized the well read clinician will extend his questioning to include data in the history which may assist him in making his first diagnosis of a new syndrome Scarcely a year has passed in the last thirty or more years even to the past month that my case taking has not had to take new syndromes into account

The formal history outline has as its purpose then the suggestion for lines of questioning that the student may follow *but it is essential that history taking never degenerate into the mechanical recording of answers to a set of stereotyped questions!* The student must ex plore any field opened by his interrogation no matter where it may seem to lead Having thus clearly set forth the function of the outline for history taking I hardly need comment upon the formalized printed history forms commonly sold to physicians for their office records Anyone believing in the importance of history taking will

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ground to the latter part of the history In this way the patient is permitted to recount the symptoms and complaints which brought him to see his physician The following plan of history taking is one that is commonly used and which we have followed for years

Identifying Information It is worthwhile I believe to have a note concerning certain identifying information before the body of the history is begun This will be a record of the *name* sex *age* and *race* of the patient The *marital state*—whether single married divorced or widowed—is important so also is the *occupation* (In hospitals and organized clinics this is usually a part of the admission record)

Chief Complaint (C C*) This should be a simple statement of the patient s complaint in his own words and should be recorded as such insofar as it is possible It should consist of one or a few words or a phrase or two Thus the chief complaint may be something like the following examples indigestion headache, diarrhea or running off of the bowels pain in the chest backache ' sore on the privates pain in the foot and the like In this way the recording of another physician s diagnosis or interpretation of symptoms may be avoided if the patient by chance has *consulted one* Thus the chief complaint should not be in such terms as gallstones stomach ulcer or colitis

Multiple complaints are sometimes encountered and are always suggestive of one of the psychoneuroses Such a complaint may run as follows My head hurts I am dizzy I can t swallow, my heart pounds I am blown up with gas and my back hurts

Present Illness (P I) This represents a record of the complaints which brought the patient to the doctor and amplifies the chief complaint This portion of the history is the one that requires the most art in history taking It demands a knowledge of disease which comes only with experience This is so since judicious questioning must bring out the details of the patient s complaints Only a few patients are so observant that they can give the whole story of their present illness without questions (*When one* encounters a patient in whom the story is too good the historian usually is suspicious that the patient

* The abbreviations given are those commonly used and recognized in hospital practice

not care to be limited to one half or even to a full length line for the information gathered concerning the gastrointestinal system or the cardiovascular system for example A blank sheet of paper is much better so that any information of importance may be expanded Thus my injunction to the novice is as follows Use the history outline merely as a key to open the gate, and then give free play to the imagination in following any path into which the questioning may lead In this way the field of clinical disease may be explored to the fullest

As will appear below, the patient should be permitted as far as possible to tell his story after the historian has started the train by certain pertinent questions Nevertheless he may need to interject questions at intervals to bring the patient back to the subject of the moment if he tends to wander Also interrogation may be necessary to amplify given information The beginner must avoid leading questions Such questions permit a "yes or no' which may not be helpful and even may be misleading Such questions are especially dangerous with suggestible persons and make a history useless at times Often it is wise to check answers or statements by returning to them by a circuitous route of questioning

PLAN OF HISTORY TAKING

The taking of a history should follow a definite scheme in order to avoid omissions Each physician may develop his own plan and probably will do so with the passage of time It is quite immaterial in which order he collects his information but he should follow a set plan so that he does not omit any important details

Since the objective is to obtain an over all evaluation of the patient some feel it is more logical to begin with the background in terms of family history, social history and then past history Such a scheme leaves the recounting of the patient's current illness to the last By this time the patient is likely to be tired and somewhat out of patience since he cannot see the point of all this background material He came because of a present complaint Therefore I join with most teachers in history taking in the plan more logical to us of making a record of the patient's present complaint first leaving the back

in a history suggestive of peptic ulcer It may be essential to know in the case of headache that the use of the eyes for close work is not the cause of this symptom

Many patients will tend to wander in their story of the present illness and the historian must by questioning direct him back into the logical development of his history This can be done more easily if the patient is kept to a chronologic recounting of his symptoms It simplifies history taking and makes for a better clinical picture if a chronologic plan is followed

System Review After obtaining as much information as possible by the above mentioned methods the student should review the various body systems for evidence of disturbances in their sphere *as related to the present illness* The patients often do not associate seemingly irrelevant symptoms with their chief complaint Only questioning may bring out these symptoms and associations This can be well illustrated in the case of thyrotoxicosis for example where several systems may be affected The chief complaints in such a case may be nervousness fatigue and weight loss' As part of the present illness questioning might reveal the following (1) that vision is abnormal and that the eyes have become more prominent (2) that swallowing is at times affected and that the throat feels full (3) that the voice is husky and that there is some breathlessness on exertion (4) that there is palpitation in excitement and upon exertion (5) that the appetite is changed and that loose and frequent stools occur (6) that the menses may be abnormal and that the sex drive may be altered (7) that the patient can stand cold better or prefers cold to heat and (8) that there is emotional instability since the patient tends to weep *more easily* All or some of these points brought out only by questioning relative to *each system* aid in rounding out the complete clinical picture of thyrotoxicosis

Some feel that a *system review* in the present illness is needless since such a review is made in taking the past history that is if the patient is questioned regarding diarrhea in the past he is reminded let us say that he has had it in the recent weeks as part of the present illness It is true that the present illness thus may be rounded out upon taking a past history I feel time is lost, however by such a plan since the clinical pattern of the present illness is not completed

has read about his symptoms or has already been through the hands of another physician who has asked the questions)

As an example let us consider a patient who has a peptic ulcer It is likely that he will say in effect that he has a "pain in the pit of the stomach (abdomen) and that he has 'gas' and belches " The physician by questioning knowing the symptomatology, will bring *out that* the epigastric pain recurs in bouts for some days weeks or months that it appears at a certain time after meals that it is relieved by food and alkalies that it may awaken him at night, and that it may be localized or may be referred straight through to the back

Until the beginner knows enough characteristics of disease, he can learn only by history taking He should thus follow a plan somewhat as follows The patient may be asked to name the approximate date of onset of his chief complaint either specifically or in terms of 'three weeks ago, ' six months ago, or a year ago It is also worth recording what the patient thinks as to the cause of, or event which led to the chief complaint After this he should be asked to describe the progression of his symptoms or complaints Questions which may always be used until disease syndromes are known may be *What? Where? When? How* modified changed or relieved by *What?* For example the what may be a pain the where the site of the pain and its radiation the when the time of pain the how modified changed or relieved by what the relief of pain by food or soda in the case of abdominal pains the aggravation of chest pain by breathing the backache increased by stooping and the like

If the disease is characterized by recurrent similar attacks it may be necessary to describe only one of these making note of variations or complications which may have occurred in other attacks Often it is best to obtain a description of the last bout since this is probably the freshest in the patient s memory

One of the most difficult facts of which to convince students is that *negative* information may be and often is, of as great or even greater importance than *positive* information For example if the chief complaint is chest pain it may be of as great importance to know that the pain is not exaggerated by inspiration as that it is Also, it is important to know that no blood appeared in the vomitus,

of following anatomic divisions may be used in obtaining the rest of the information in this section Thus questions are asked concerning past diseases or symptoms involving the *head eyes ears nose throat mouth* and *teeth* The past symptomatology of the *respiratory cardiovascular* and *gastrointestinal systems* is reviewed by questioning So too the *genitourinary system* including the menstrual history and the *neuromuscular system* are investigated in a like manner

From such an inquiry the student may hope to have an over all view of the patient s past health and illnesses The use of a form as a key for questioning is permissible in taking the past history and will appear below The guide to semiology which also appears below may be useful in filling out the diseases and symptoms uncovered in the past history

Personal History (Per H) This section of the history has as its purpose the provision of information about the patient s environment and what manner of person he or she is This will include therefore answers as to the marital status sexuality and sexual practices the health of the spouse if living the cause of death in a deceased spouse divorces and the reason for these and a history of pregnancies and miscarriages in a woman or in the wife if the patient is a male Note should be made of the time in the course of the pregnancy at which it was interrupted Such information at times is of key importance in certain illnesses Places of *residence* at times have bearing upon disease especially in the case of certain exotic diseases Obviously *habits* particularly as related to alcohol tobacco and drugs may be significant *Occupation* likewise often is a factor in disease and therefore may be described in detail *Education training accomplishments steady employment social and economic background* are essentials in the evaluation of the person as a whole *Personality traits hobbies religion* and the like offer valuable clues to the patient s psychologic make up

The items of the personal history should permit an evaluation of the patient s personality At this point the physician will have learned whether the patient is a stable well adjusted intelligent person or whether he is dealing with *an unstable* psychoneurotic hysterical obsessive a compulsive personality and/or one who is unintelligent

until the end of the history Facts picked up late in the history will need to be inserted into the present illness

Every clinician uses a system review in his present illness With time admittedly, he chooses those systems for review which may be *pertinent to the present illness* For example, inquiry may not be made relative to cardiac symptoms if the present illness is clearly that of peptic ulcer But inquiry regarding cardiac symptoms may be much to the point in a present illness seemingly that of pulmonary disease

Past History (P H) The purpose of the past history is to obtain a record of the patient s past health illnesses operations and accidents This information is generally gained best by direct questioning in order to conserve time and to obtain data in an orderly fashion It would be asking a lot of the patient to expect him to recall the items having to do with health in chronologic order over a period of decades Thus the method differs from that used in the present illness being a question and answer approach

So that the data of the past history may be obtained as quickly and in as good an order as possible the questions should be posed in a pattern to meet these objectives The system employed varies from medical college to medical college and hospital to hospital The system we have followed at Vanderbilt University School of Medicine has been somewhat as follows

General Information *General health growth* and *development* as a child are inquired into Next *acute infectious diseases* which the patient has suffered are recorded as well as *operations* and *accidents* As a warning to the student I should like to emphasize that it is well not to accept diagnoses of acute infections without an inquiry for details which might be helpful in satisfying one s own mind that the diagnosis was correct Thus if the patient states that he has had pneumonia or typhoid fever for example I prefer to learn something of the course of the illness and complications if any Similarly it may be well to attempt to obtain at least some details in addition to the dates concerning operations and accidents The past history concerning *allergy* is important at times in the interpretation of the symptoms of the present illness

Specific Anatomic Divisions After these more or less general topics of the past history have been covered by questioning a logical order

injection of drugs inhalants or other possible allergens Manifestations of *gastrointestinal allergy* are most likely to appear under the inquiry concerning gastrointestinal diseases

Disturbances in Nutrition Here history taking will include not only the disturbances related to calories increase or decrease in weight but also those having to do with the specific nutrients The history may reveal vitamin deficiencies in terms of changes in the epithelium of the conjunctiva skin and mucous membranes particularly those of the gastrointestinal tract (from a glossitis achlorhydria and diarrhea to irritation of the anus) Pigmentary changes may occur The inquiry may need to include symptomatology regarding vision evidences of increased capillary fragility manifested by bleeding in mucous membranes or skin manifestations of anemia and disease of the central nervous system (subjective evidence pointing to disease of the posterior columns of the spinal cord as paresthesias ataxia sphincter disturbances disturbances in sensation and less commonly disturbances of the cortex manifested in mental confusion) The nutritional history must include a careful analysis of the quantity and variety of food intake and alcoholic drinks

Blood Dyscrasias The constitutional manifestations of anemia whether they be of the nutritional type or secondary to blood loss chronic infection malignancy or leukemia consist of weakness ease of fatigue breathlessness upon exertion and varying degrees of dependent edema In searching for blood loss the history must be painstaking especially in the portions related to the gastrointestinal and genitourinary systems Hemolytic anemias may reveal a history of jaundice and in the Negro the additional manifestations of sickle cell disease abdominal crises and ulcers of the lower extremities Abnormalities of the bleeding or coagulative mechanisms account for the symptomatology of easy bruising bleeding from the mucous membranes especially the gums and nose as well as from other sources In hemophilia prolonged and recurrent bleeding into joints may be prominent The symptoms of the leukemias may consist of those due to the anemia at times attendant purpura and ease of bleeding and a complaint of lymphadenopathy and abdominal masses (spleen and liver)

Diseases of Metabolism and the Ductless Glands *Diabetes mellitus* Symptoms due to loss of glucose in the urine may represent weight loss polyuria with resultant polydipsia pruritus of the genitalia in women and recurrent pyogenic infections of the skin The symptoms of acidosis may be those of headache drowsiness and somnolence and occasionally abdominal pain in precomatose states Late symptomatology may be related to cataracts the effects of vascular disease in the extremities and neurologic manifestations because of nutritional deficiences *Hyperthyroidism* commonly may give the symptoms of weight loss with increased appetite nervousness manifested in overactivity weakness ease of fatigue palpitation breathlessness at times and diarrhea Tremor and sweating are frequent Pigmentary changes may occur in the skin *Hypothyroidism* Here the history will probably indicate sluggishness ease of fatigue swelling of tissues hoarseness and the complaint of being cold In either disturbance of

Social and Environmental History The information gathered under this heading may be applicable only in selected cases Some of this information is of specific interest in infectious diseases from the viewpoint of epidemiology or preventive medicine and public health Other information is valuable background material in psychiatric disturbances

Family History (F H) This is important in chronic and degenerative diseases Here, the physician will get information concerning longevity or the reverse in the family, by asking questions about the age and cause of death of parents grandparents uncles, and aunts as well as of siblings

Questioning is directed also to bring out a family incidence of allergic and degenerative diseases chronic infections neuropsychiatric disorders and the like

SEMIOLOGY

As has been said, it will be some time before the student has had enough experience to amplify the patient s history with pertinent questions in the hope of attaining a tentative diagnosis The following may provide some ideas for the development of histories as related to the systems or in other broad categories *It must be emphasized that this is merely a sketch or skeleton to be filled out in all cases with more details* (This guide may also be used to flesh out items in the past history)

Allergic States Here the history should reveal the seasonal or perennial nature and duration of attacks In *hay fever* there will be stuffiness of the nose or actual obstruction accompanied by a serous or seromucoid nasal discharge and itching and at times redness of the conjunctivae Sneezing is prominent In *asthma* there may be tightness of the chest with or without wheezing which may be noted in expiration only to outright dyspnea Ineffectual cough is common during the attack and a cough productive of thick mucoid sputum at the end of an attack is characteristic For months or years true asthma may be masked by unaccountable paroxysms of coughing at intervals A detective like approach is needed in searching for allergens suspicions being raised by the circumstances or surroundings in a given attack The diurnal or nocturnal attack the occupation food eaten exposure to animals and cosmetics in the environment offer in the aggregate a wide field for investigation *Urticaria* and the *serum sickness* type of reaction (fever and swelling of tissues or structures of the body as skin larynx muscles joints) require careful inquiry regarding foods ingestion or

injection of drugs inhalants or other possible allergens Manifestations of *gastro-intestinal allergy* are most likely to appear under the inquiry concerning gastro intestinal diseases

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thyroid function the symptomatology may reveal disturbances in menstruation and in sexual libido and potentia *Hypoadrenalism* is characterized by weakness asthenia weight loss and pigmentation of the skin and mucous membranes Crises of vomiting and diarrhea are outstanding changes in sexual function will be manifested *Pituitary disease* provides a symptomatology which is due in the main to the lack of the trophic hormones and the decreased activity of the respective endocrine glands Disturbances in vision may result from encroachment upon the optic tract by tumors within the sella

Respiratory System Sinusitis in the acute stage will be manifested by pain referred to the regions of the antra and frontal sinuses particularly stuffiness or obstruction of the nose to be followed by mucopurulent nasal and postnasal discharge Chronic sinusitis is associated with persistent postnasal discharge Inflammatory neoplastic or neurogenic disturbances of the larynx lead to the symptoms of nonproductive irritative cough and hoarseness Cough productive or nonproductive of sputum is the symptom common to disease of the trachea bronchi bronchioles or pulmonary parenchyma whether infectious or due to tumors intrinsic or extrinsic (Tumors include aneurysms of the great vessels hypertrophy of the mediastinal lymph nodes and primary or metastatic malignances) Hemoptysis varying from streaking to copious quantities may accompany these symptoms Involvement of the pleura by infection or by tumor will be productive of pain with localization depending upon the nerve supply involved Pleural pain is accentuated by respiratory movements coughing and the like Spontaneous pheumothorax is manifested usually by pain and breathlessness Pleural irritation is accompanied by nonproductive cough Breathlessness is a common symptom in pulmonary disease whenever there is decreased vital capacity below the patient s normal minimum whether due to pulmonary consolidation emphysema pleural disease or cardiac disease

Cardiovascular System *Arrhythmias* The symptomatology will call attention to palpitation irregularity or skipping of beats tachycardia or bradycardia symptoms of onset and offset of the periods of arrythmia must be carefully noted

Cardiac Pain Pain of cardiac origin is occasionally precordial or epigastric more commonly substernal or retrosternal with radiation to the left shoulder and arm at times to both upper extremities and the neck Inquiry must include data concerning the factors producing pain duration of the pain and the mechanism of relief

Congestive Failure The symptoms may include breathlessness on exertion or at rest orthopnea paroxysmal dyspnea cough which may be productive of sputum at times blood tinged palpitation dependent edema and at times enlargement of the abdomen due to ascites Weight gain may be important

Peripheral Vascular Disease Impairment of the blood supply to the extremities gives the symptoms of changes in color coldness nocturnal cramps in the legs and intermittent claudication Vasospasm may be related to cold

Gastrointestinal System *Esophageal disease* may provide the symptoms of

dysphagia regurgitation of food a sense of retrosternal tightness on swallowing or the inability to swallow food especially solids

Stomach The pain of gastric disease is commonly referred to the epigastrium the lower left chest or upper abdomen generally A sense of fullness nausea and vomiting and anorexia may accompany disease of the stomach as well as of the duodenum

Pain from *duodenal disease* is commonly epigastric in the right upper abdomen and at times referred to the back

Gallbladder Pain is commonly referred to the right upper quadrant or epigastrium frequently radiating to the subscapular or scapular area less commonly along other routes

Gallstone colic usually is a severe colicky pain commonly doubling the patient up and of epigastric location or below or at the right costal margin The history may reveal jaundice subsequent to an attack

Disease of the *small bowel* is likely to be characterized by diarrhea with or without cramping With obstruction there will probably be pain abdominal distention and later nausea and vomiting

Appendix Acute inflammation commonly gives the story of epigastric pain nausea and vomiting with subsequent localization of pain in the right lower quadrant

Colon (ascending transverse and descending) Ulcerative malignant or benign lesions will probably be accompanied by gaseous distension loose stools with or without cramping containing at times blood and mucus Those of infectious origin may be accompanied by the constitutional symptoms of infection Obstructive lesions result in pain with abdominal distension and later nausea and vomiting Irritability of neurogenic cause is characterized by cramping loose stools containing mucus and by gaseous distention

Sigmoid Colon The commoner obstructive lesion will present the symptomatology of increasing constipation abdominal distention and discomfort in the left lower quadrant The symptoms of diverticulitis may be very similar

Pancreas Acute pancreatitis accompanied by mild and indefinite symptomatology in some cases may give the story of severe upper abdominal pain possibly radiating to the back with associated vomiting In chronic pancreatitis the story is that of recurrent attacks reminiscent of acute pancreatitis later diarrhea may be an outstanding symptom attended by marked weight loss *Liver* The progressive course of hepatic cirrhosis reveals a history of progressive anorexia weight loss indefinite abdominal discomfort possibly jaundice constipation vomiting of blood from esophageal varices and ultimately abdominal distention due to ascites

Disease of the gastrointestinal tract makes it essential to gather historical data concerning anorexia nausea vomiting and bowel habits as related to the intake of food or other factors characteristics of the stool or information concerning possible blood loss The maintenance or loss of weight are important

Genitourinary System *Kidney* In acute nephritis there may be the story of headache anorexia nausea edema oliguria and hematuria with at times discomfort referred to the flanks Infectious disease of the kidneys will be characterized by fever frequency dysuria at times hematuria and pyuria and pain referred to the renal area Tumor of the kidney may be asymptomatic or present as a mass or fullness of which the patient becomes aware or gross hematuria may attract attention

Ureteral pain whether inflammatory or due to stone is referred to the flank or renal area with radiation commonly to the lower quadrant or genitalia on that side

Bladder Irritation whether due to infection or tumor commonly provides symptoms of frequency and urgency of urination burning or dysuria lower abdominal discomfort at times gross hematuria

Prostatic disease may be characterized by obstructive symptoms of urgency frequency inability to control the urine difficulty in starting the stream or evidences of obstruction

Scrotal Contents Inflammatory or neoplastic disease of structures within the scrotum may be either painful or painless Swelling and tenderness are common Hernial enlargement commonly is variable *Urethral* discharge may be of various types and associated with varying degrees of discomfort

Ovaries and Tubes Inflammatory or neoplastic processes commonly produce symptoms of discomfort or pain referred to the involved side and not infrequently the bladder symptoms of frequency burning and dysuria Ovarian disease as well as lesions of the *uterus* may be manifested by menorrhagia metrorrhagia or amenorrhea

Vaginal discharge either with or without blood may be manifestations of uterine or vaginal disease

In both sexes changes in *sexual libido* and *potentia coeundi* may signify either organic or functional disturbance

Musculoskeletal System Disease of *skeletal muscles* will present the symptomatology of pain either with or without movement tenderness and swelling of muscles

Joints The symptoms of stiffness swelling pain redness heat tenderness and their aggravation by activity will be characteristic

Disease of the *bone* whether infectious metabolic or due to metastatic neoplasm may be characterized by deep bone pain and/or pathologic fractures

Nervous System Derangements of the central nervous system or peripheral nerves may present symptomatology of a multitude of variations by presenting disturbed function of eiher the sensory and/or of the motor side

Cutaneous System In the skin diseases the history will need to include data concerning the morphology of lesions their appearance course presence or absence of pruritis sensory aspects relationship to possible contact with irritants and relationship to constitutional symptoms or symptoms of other body systems

OUTLINE OF HISTORY TAKING

VANDERBILT UNIVERSITY HOSPITAL, MEDICAL SERVICE

Outline for History Taking

Chief Complaint

(This is usually the answer to the question What symptom brought you to the hospital? and should be limited to a succinct word phrase or sentence)

Present Illness Including all relevent material since the date of onset This should be clear complete and concise

First determine as accurately as possible the date and manner of onset Then the procedure will vary somewhat according to whether the patient has had a short or long illness one that has been continuous or one that has occurred in attacks In general develop the illness chronologically analyzing each symptom as it arises Symptoms not volunteered but suggested by the clinical picture should be inquired for and their presence or absence noted *Avoid omissions by inquiring briefly for symptoms originating in the main systems of the body* Inquire into the effects of the present illness on the patient s general strength mental attitude and social situation The patient s previous treatment should be noted identifying the medication if possible Arrange the story of the present illness in as logical an order as possible

Past History Including everything preceding the present illness

General health and strength Growth and development as a child

Acute Infectious Diseases Measles mumps whooping cough chickenpox scarlet fever chorea typhoid pneumonia pleurisy arthritis malaria influenza tonsillitis tuberculosis syphilis gonorrhea *Any other diseases* Inquire by symptom as well as by name History of exposure to infectious diseases and of protection against them

Accidents and/or operations

Manifestations of the allergic state (asthma hay fever urticaria)

Head

Headache

Eyes—vision diplopia inflammatory disease glasses

Nose—colds obstruction epistaxis

Ears—hearing earache discharge tinnitus vertigo

Mouth—sore mouth bleeding or receding gums sore tongue ulcers salivation

Teeth—pain decay devitalization extraction

Throat—sore throat tonsillitis hoarseness

Respiratory Pain in chest dyspnea cough sputum hemoptysis night sweats fever

Cardiac Palpitation dyspnea orthopnea pain or distress over precordium radiation of pain edema cyanosis weakness

Genitourinary System *Kidney* In acute nephritis there may be the story of headache anorexia nausea edema oliguria and hematuria with at times discomfort referred to the flanks Infectious disease of the kidneys will be characterized by fever frequency dysuria at times hematuria and pyuria and pain referred to the renal area Tumor of the kidney may be asymptomatic or present as a mass or fullness of which the patient becomes aware or gross hematuria may attract attention

Ureteral pain whether inflammatory or due to stone is referred to the flank or renal area with radiation commonly to the lower quadrant or genitalia on that side

Bladder Irritation whether due to infection or tumor commonly provides symptoms of frequency and urgency of urination burning or dysuria lower abdominal discomfort at times gross hematuria

Prostatic disease may be characterized by obstructive symptoms of urgency frequency inability to control the urine difficulty in starting the stream or evidences of obstruction

Scrotal Contents Inflammatory or neoplastic disease of structures within the scrotum may be either painful or painless Swelling and tenderness are common Hernial enlargement commonly is variable *Urethral* discharge may be of various types and associated with varying degrees of discomfort

Ovaries and Tubes Inflammatory or neoplastic processes commonly produce symptoms of discomfort or pain referred to the involved side and not infrequently the bladder symptoms of frequency burning and dysuria Ovarian disease as well as lesions of the *uterus* may be manifested by menorrhagia metrorrhagia or amenorrhea

Vaginal discharge either with or without blood may be manifestations of uterine or vaginal disease

In both sexes changes in *sexual libido* and *potentia coeundi* may signify either organic or functional disturbance

Musculoskeletal System Disease of *skeletal muscles* will present the symptomatology of pain either with or without movement tenderness and swelling of muscles

Joints The symptoms of stiffness swelling pain redness heat tenderness and their aggravation by activity will be characteristic

Disease of the *bone* whether infectious metabolic or due to metastatic neoplasm may be characterized by deep bone pain and/or pathologic fractures

Nervous System Derangements of the central nervous system or peripheral nerves may present symptomatology of a multitude of variations by presenting disturbed function of eiher the sensory and/or of the motor side

Cutaneous System In the skin diseases the history will need to include data concerning the morphology of lesions their appearance course presence or absence of pruritis sensory aspects relationship to possible contact with irritants and relationship to constitutional symptoms or symptoms of other body systems

any familial or hereditary disease State whether members of the family or associates have or have had trouble similar to that of the patient

MENTAL STATUS Comment upon your impression of the reliability of the patient s statements and his general mental status

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7 ROBERTSON W E and ROBERTSON H F Diagnostic Signs Reflexes and Syndromes F A Davis Co Philadelphia Third Edition 1947
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Gastrointestinal Appetite and digestion pain with its relation to eating eructation nausea and vomiting hematemesis regularity of bowels diarrhea stools (clay colored tarry fresh blood) hemorrhoids jaundice

Diet Character and amount

Genitourinary Dysuria pain nocturia hematuria polyuria oliguria edema of face retention urgency dribbling incontinence smoky urine enuresis

Menses Age of onset regularity duration amount date of last period menorrhagia metrorrhagia vaginal discharge dysmenorrhea amenorrhea

Neuromuscular Memory, nervousness insomnia sleep walking vertigo tremors convulsions paralysis paresthesia anesthesia girdle shooting muscular or joint pains

PERSONAL HISTORY

Marital Duration health of partner pregnancies chronologically with duration of pregnancy in any miscarriage and age and health or cause of death of children Adjustment problems?

Place of birth and of residence

School and education Cause of any limitation

Habits Regularity of eating and sleeping exercise tea coffee tobacco alcohol drugs or medicines

Occupation Past and present work conditions of work exposure to occupational disease how long at present work why previous work was given up vacations

Personality Traits Outgoing sociable energetic easygoing quiet introspective moody or inclined to worry complaining quick tempered meticulous fearful

Weight Usual weight best weight with date present weight and duration of recent loss or gain

SOCIAL AND ENVIRONMENTAL HISTORY

Housing Number rooms number occupants sleeping arrangements furnishings (beds and other furniture) electricity gas water connection bathing facilities screening excreta disposal

Neighborhood Congested or open proximity to special or unusual places or buildings general atmosphere Distance from hospital as it affects future medical care

Community Activities Movies social settlements clubs sports hobbies church as religious or recreational influence

Additional Social Financial and Personal Problems

Evaluation of Above Problems As they affect the medical problem

FAMILY HISTORY General health and longevity of family health or cause of death of parents number of brothers and sisters with ages at death History of tuberculosis (giving patient s association therewith) rheumatism gout diabetes cancer hemophilia obesity nervous breakdown mental disease or

FUNCTIONS OF NERVOUS SYSTEM

The function of the nervous system is primarily to bring together these collections of organ systems as a useful adaptive whole This process of adaptation carried on by the nervous system is twofold (1) It adapts the organism to its external environment through the ability of sensory receptors on the exterior to convert physical stimuli into nerve impulses which are then integrated into useful patterns of action by *the central nervous system* to be carried into effect through motor nerve discharges (2) The internal adaptive faculties are accomplished through the autonomic nervous system The integration of its activity to the external environment is as with the peripheral nerves effected through the central nervous system

It is important to note since it furnishes the basis for psychosomatic medicine that both autonomic and peripheral nervous system activity is controlled by the central nervous system and that inhibition of discernible external motor response does not prevent the accompanying activity in the autonomic system There is evidence that the reverse occurs that is autonomic activity is greater when the external motor response is inhibited Thus the nervous system functions to maintain the totality of the adaptive faculties of the body and to permit it to function or better to cause it to function as an independent structure cooperating with and combating its environment both internal and external

There is no doubt that the anatomic physiologic unit of the nervous system is the reflex arc In a clinical orientation this fact is in the main neglected unless one wants to include all human activities as reflex arc function Certainly this is possible for preceding every action is stimulus integration and coordination In the reading of this book the light or better the absence of it from the printed letters serves as a stimulus by forming a pattern on the retina and is there converted to neural impulses transmitted to the occipital cortex Then through various pathways it becomes meaningful and is stored by means still imperfectly understood The external response to the stimulus of these unheard words may appear months or years later possibly on an examination Thus by ignoring the time element, all things may be considered as reflexes Clinically it is no more cogent

2. THE BODY IN ACTION

WILLIAM F ORR M D *

THE PURPOSE OF this chapter is to serve as a bridge between the basic sciences of neuroanatomy, neurophysiology and neuropathology on one hand and that portion of internal medicine called clinical neurology' on the other In order to do this, it is necessary to understand the function of the nervous system in the living human being, not as a preserved laboratory specimen of a portion of him nor as an isolated neurophysiologic phenomenon To this end, we must ask and answer two questions (1) What is the function of the body? (2) What role does the neurologic system play?

FUNCTIONS OF BODY

Stripped of all but its teleologic implications, the human body has but two functions (1) to maintain itself and (2) to reproduce its own kind All of the organs of the body contribute their part to this functioning In broadest outlines the integument serves as a protective coat to guard the internal structures, the bones preserve a rigid framework the joints allow and muscles produce mobility, the digestive system supplies nourishment from the external world to the circulatory system which in turn distributes it to the entire structure along with oxygen the ancillary carbon dioxide—oxygen exchange is accomplished through the respiratory system the urinary system rids the body of its water soluble superfluities and maintains water balance the reproductive system continues the species

* *Professor of Psychiatry and of Neurology Vanderbilt University School of Medicine*

attributes His autonomic centers function incompletely in that he is more dependent upon protection to maintain a bodily temperature however his respiratory and circulat[illegible]atory mechanisms are fairly well developed His movements of the gastrointestinal tract are functionally active so that in the sense of autonomic adaptation the child is fairly well organized His external adaptive faculties however are puny He has a sucking reflex in which the mouth assumes a sucking puckering movement on tapping at the outer margins of the lips The tongue will force food to the back of the throat so that deglutition can occur He responds to loud noises with startle phenomena and to sudden postural changes by a sudden throwing out of his arms and legs as if to catch himself Tonic neck reflexes exist in which the homolateral arm and leg are extended and the contralateral arm and leg flex on the turning of the neck he turns his head slowly to light masses but is apparently unable to see The tonic foot reflex and the grasp reflex in the hand are well developed He is able to contract his vocal cords and to express air briskly through them in a cry His movements are futile and useless in terms of protecting himself they are incoordinate and haphazard usually bilateral His sense of cutaneous pain is poorly developed and is heedless of stimuli which would be extremely painful in an adult

It is interesting that the first advances that one sees in the growth of the infant are really inhibitions of the few attributes which he has From the very beginning the tonic neck reflex becomes less and less important and the child is able to keep his head in a midposition without the attendant movements of the arms and legs Startle phenomena the grasp reflex and the sucking reflex are less evident within a few weeks after birth These are replaced as it were by things of a higher order The child begins to show sucking phenomena at the time he is hungry or when he is placed in the usual position of nursing His eye movements become more coordinate the eyes move together rather than without conjugation and in about four to six weeks he begins to see Soon after the child is able to coordinate the eyes the other nuclei and tracts associated with eye movements are brought into action and the median longitudinal fasiculus together with the tectobulbar tract correlating the movements of head and neck to sound and light begins to function

to consider this anatomic physiologic unit than it is necessar ponder the physical forces in a molecule of water in order to qu one's thirst

Clinical neurology is the study of the adjustment, in reality failure of adjustment, of the neural organization of man, and th best understood in terms of total function Even in utero, the f responds chiefly by mass phenomena that seem to have purposive If one area of the fetus is stimulated a torsion of the entire body t place with twisting and turning which is much more highly integr than simple reflex arc activity Yet even in the fetus, the sin reflexes which can be easily demonstrated are of secondary im tance Observationally, we are interested in the motor patterns w fetus, infant child, adolescent adult or senile exhibit, whether t motor patterns are extremely simple or unbelievably complica Actually, our interest in clinical neurology is in the loss of the n highly integrated motor patterns and the substitution for these hi levels by ones less useful in the broader aspects of adaptation th patterns more stereotyped more automatic, more dependent u external stimuli, and therefore not as variable or capable of mee multiple environmental demands

Ontogenetic Aspects

At birth, the human animal s nervous system is extremely po developed in contrast to the other bodily systems With the clos of the ductus arteriosus, the circulatory system is approximately adult form With the full expansion of the lung a few hours a birth, the respiratory system works as efficiently as it does through the person s life The digestive system though not entirely compl within a year or so functions on a mature level and the same is t of the excretory system Only the reproductive system is nonfu tional, and even this becomes mature before the nervous syst reaches its maximal development

Neurologic Functions at Birth Possibly an examination of neurologic functions at birth may serve as a starting point in study the development and integration of the nervous system and may considered the lowest level The infant then has a few neurolo

Positive and Negative Symptoms The meaning then of the Babinski phenomenon in an adult must be expressed in two ways The more important significance is the loss of the normal plantar reflex and its secondary replacement by a pattern of lower order The first is called the negative symptom and the second or substitution phenomenon, the positive symptom We must be aware at all times that the positive symptom is merely a secondary elaboration of those portions of the nervous system remaining intact It is the negative symptom that indicates the area of loss It is to be noted that in lesions of the highest level the positive symptom is quite complex whereas in lesions of the very low levels the positive symptom may be absent

This is illustrated by the following examples (1) In lesions of the frontal cortex loss of memory is a frequent result (negative symptom) It is usually discovered on examination by the fact that the patient is overtalkative, as if to ward off questions which he is unable to answer and by circumlocution in which he talks around a question rather than answering it (complex positive symptoms) (2) In a person with diminished volitional control of his legs due to an incomplete lesion of his pyramidal tract the complaint is usually weakness (negative symptom) stiffness of his legs and on examination hyperactive reflexes (simple positive symptoms) (3) In a complete lesion of the peripheral nerve the complaint is numbness and paralysis which are confirmed on examination (all negative no positive symptoms)

Phylogenetic Aspects

Not only must we consider the nervous system in its ontogenetic aspects but also in its phylogenetic for though in man we can see the parallel development in some instances this is not always true The human animal for instance at the age of four has far surpassed the dog tiger or bird in his highest levels of integration namely his intellectual function though he in no way compares with these animals in dexterity of motor function In certain diseases we find whole systems of action being disintegrated as it were from the rest of the central nervous system The patient with basal ganglia disease

The movements of the arms remain incoordinate, since the cerebellar pathways are not functionally useful until sometime after the first half year of life Even at this time, the pyramidal tracts and posterior columns are not entirely functional, and it is only after the child has passed his first birthday that bipedal locomotion is a human attribute Speech is still larval at this time, and though the idea of communication exists, the ability to abstract symbols is not a useful part of the organism until about two years of age At this time, the grasp and tonic foot reflexes have been entirely replaced in the foot first by the Babinski and later by the normal plantar response The arms now may function independently one of the other and their movements are no longer bilateral Adaptive desires have replaced reflect pathways dependent solely on external stimuli for their initiation

Neurologic Functions in Later Life As the years pass, the most highly integrated functions are added those which are commonly grouped together and called intelligence

This seems to be ability to correlate many stimuli into adaptive, useful wholes and to suppress those stimuli which, though as strong are not a meaningful part of the total stimulus pattern This development of the ability to inhibit the response to stimuli is one of the higher orders in integration It is to be remembered that as each succeeding developmental level replaces the preceding ones it does not nullify them for in senility and in certain diseases the lower levels of integration can be shown to be present still and though dormant, remain as basic patterns of action within the nervous system

The scheme of integration of the nervous system is repeated in reverse order during disintegration either in disease or in the aging process In far advanced senility the grasp reflex sucking reflexes and incoordinate movements similar to the newborn infant can be demonstrated A further example of this is the successive integration foot reflexes In the earliest phases of development a tonic foot reflex is present later replaced by Babinski phenomena and finally by the normal plantar response Thus the finding of a tonic foot reflex on examination means that there has been more profound general disintegration of the nervous system than the presence of the Babinski phenomena

stimulus to the next so that as long as tension is placed on the Achilles tendon the ankle jerk continues its series of contractions There are innumerable examples of reflex series of varying complexities such as sneezing vomiting urinating and defecating All apparently have sensory trigger zones stimulation of which initiates a reflex, this reflex leads to a second sensory stimulation and a second reflex and thus to a third and so on until the final motor response may occur in an area far removed from the initial stimulus and be related to it only in terms of purpose In nearly all sequences or all acts except the simplest many systems contribute either directly or indirectly to the adaptiveness of the act itself As an example the identification of an object in one s hand is dependent not only upon the intactness of the parietal cortex for which it is usually considered a test but upon the functioning of the peripheral nerves posterior columns and thalamus on the sensory side the frontal cortex internal capsule pyramidal tract final common path motor nerves and muscle on the effector side not to mention the ancillary basal ganglia which maintain the posture of the individual while carrying out the test or the autonomic nervous system which must be functioning to maintain proper circulation to the hand cord brain and to the unknown but very important aspects of the personality known as consciousness volition and will

EXAMINATION OF BODY IN ACTION

In examination of the body in action we are interested in two different types of condition (1) the general level of functioning of the nervous system and (2) focal defects of clinical significance Most of the so called neurologic diseases are of a focal nature whereas disturbances of total nervous system function are more likely to be physiologic exogenous or diffusely degenerative Of the physiologic disintegrations of the nervous system generally the commonest is sleep Other causes are extreme *fatigue* anoxia hypoglycemia and drugs of various sorts Surgical anesthesia barbiturates and alcohol to name a few produce general lowering of the total adaptive functioning of the organisms pathologic reflexes such as Babinskis and even forms of tonic neck reflexes known as Magnus and de

such as parkinsonism may show no clinical impairment of his highest levels of integration (cerebral cortex), whereas his movements in their unregarded, postural, *static aspects may be so impaired as to* render him helpless because of rigidity and tremor However, this patient may, through volition (use of his cerebral cortex), modify and in some instances nullify this basal ganglia deficit for short periods of time by conscious effort In the case of the disintegration of that other great suprasegmental structure, the cerebellum, because of its antiquity all motor activities conscious and unconscious, those controlled and not controlled by volition, may become incoordinate and useless for adaptive purposes

Integration of Systems In every act there must be integration of all the systems of the body—sensory, motor basal ganglia cerebellar, and cortical—and the loss of any of these leads to the incomplete or inadequate performance of any act Many actions proceed *successively from the highest level of integration to a point where* the lowest level is in ascendancy To cite an example The person desires to eat an article of food, reaches for it with his hand, and places it in his mouth—this necessitates the bending of his elbow and the release of the food from his fingers the food is taken into the mouth chewed until it reaches a certain consistency, placed on the tongue, and forced to the back of the mouth, where the reflexes involving the fifth, ninth, and tenth nerves take over and the food is forced into the esophagus, there it falls into the automatic rhythm of the autonomic nervous system and the food reaches the stomach In analyzing this act, we see that the earliest portion of it namely the decision to eat the particular article springs from the highest level of the nervous system, involving anticipation abstraction and memory and is entirely subject to consciousness The grasping of it in the hand and placing it in the mouth are more automatic but still highly integrated the chewing of it puts much less demands on the highest levels, swallowing is almost entirely undirected and the movements in the throat and esophagus are beyond conscious control and are simply reflexes of low order

Reflex Series or Sequences Reflexes of every order may occur in sequences or series or may be self perpetuating As an exceedingly simple example, in ankle clonus one jerk of the ankle is sufficient

nomic nervous system activity and lastly sensation which because of its great subjectivity is the least reliable of all

Though in fact and probably in order of importance the examination of the highest level comes first it is easier to understand the examination of the lowest levels of the nervous system because of the fact that the positive symptoms in these conditions are less complex and less elaborate For example behavior changes resulting from a lesion of the left frontal lobe may be so subtle as to be noted only by those who have previously known the patient or by special psychological tests which show up disturbances of concrete and abstract thinking These changes may therefore, be undetected by the physician on the first visit with the patient whereas a lesion of the radial nerve will show up in wristdrop that should be obvious regardless of the physician s previous acquaintance with the patient and will depend only upon his knowledge of the symptoms of radial nerve disease

Symptomatology of Lesions of Nervous System

The following is designed to serve as a scheme to assist the student in becoming acquainted with the symptomatology of lesions in the various parts of the nervous system It is obviously incomplete and progressively so in the higher levels where large lesions may exist and the patient *show none of the signs listed* However in a high number of cases one or more signs will be apparent and the presence of any of them is quite indicative of a lesion in the designated area

Peripheral Nerve

Minimal or Early	*Maximal or Late*
1 Diminished reflex	1 Absent reflex
2 Paresthesia	2 Flaccid paralysis
3 Weakness	3 Loss of all sensation
4 Diminished pain sensation	4 Wasting
5 Muscle tenderness	5 Trophic disturbances

Sensory Root and/or Ganglion

Minimal or Early	*Maximal or Late*
1 Paresthesia	1 Loss of all sensation
2 Shooting pain	2 Absent reflex
3 Diminished reflex	3 Trophic disturbances
4 Diminished pain sensation	

Kleijn phenomena," make their appearance and in the final phase only the most primitive functions remain Similar states appear with anoxia whether due to strangulation carbon monoxide poisoning or the breathing of nitrogen, in insulin coma and following convulsions Even in severe fatigue, the same symptoms in a mild form occur The frequent occurrence of the Babinski phenomenon is reported in soldiers who have been subjected to long marches In all of these conditions, we find the lower levels of integration successively replacing the higher until finally only the most basic nervous action persists, and the individual is living but otherwise nonadaptive

Practical Aspects of Neurologic Examination

In the practical aspects of the neurologic examination a number of questions must be answered In order they are as follows Is there a lesion within the nervous system? Is this lesion a general one involving the entire nervous system or is it focal? Is it single or multiple? If focal where is it located? What is the nature of the lesion? Is it primary within the nervous system or secondary to disease elsewhere in the body?

Importance of History To ascertain these facts all methods of examination must be used and as with all other branches of medicine most valuable information comes from the history Though this aspect of the examination has been discussed in the preceding chapter *the observing of the patient during the process of history taking* is even more important in neurology than in other branches, since the observation of the patient while he gives his history may give us a clue to his basic illness The person who pants dyspneically throughout the recitation of his story of ankle swelling makes the history of the swollen ankles more meaningful Since the ability to give a history is a derivative of the highest levels, and the functioning of the cerebellum and fifth, seventh, ninth tenth and twelfth nerves is necessary for articulate speech, history taking *is* a part of the neurologic examination

Physical Examination In the formal physical examination special attention is paid to the following groups of neurologic functions cranial nerves motor strength and coordination reflexes auto

2 Cerebellar signs more common
3 Sympathetic signs less conspicuous

MESENCEPHALON

Symptomatology is protean variable and not subject to schematization except for the following

1 Oculomotor signs
2 Decerebrate rigidity

CEREBELLUM

(*Signs may be unilateral or bilateral*)

1 *Asynergia (failure of antagonist to relax reciprocally with contraction of agonist)* In legs these symptoms lead to staggering gait in arms intention tremor and adiadochokinesis in speaking dysarthria
2 Nystagmus (certain areas only)

BASAL GANGLIA

(Signs may be unilateral or bilateral)

1 Tremor alternating choreic or athetoid
2 Muscular rigidity
3 Disturbance of associated movements
4 Disturbance of gait and posture

THALAMUS

(Uncomplicated clinical syndromes are uncertain)

Related to lesions of the thalamus is the following

1 Thalamic syndrome (analgesia spontaneous pain and contralateral hemichorea)

INTERNAL CAPSULE

1 Contralateral pyramidal tract signs
   a Paralysis
   b Spasticity
   c Increased reflexes
   d Babinski and Hoffman phenomena

CEREBRAL CORTEX

General

1 Disturbance of highest level memory intelligence abstract thought Minor defects often obscured by positive symptoms evasiveness *impulsiveness* garrulousness and so on

Frontal Lobe

1 Contralateral pyramidal tract signs
2 Aphasia (chiefly verbal and graphic apraxia) (dominant lobe only)
3 Focal or jacksonian seizures

Motor Root and/or Anterior Horn

Minimal or Early

1. Diminished reflex
2. Weakness
3. Muscle fibrillation
4. Dysesthesia (?)
5. Muscle tenderness

Maximal or Late

1. Flaccid paralysis
2. Absent reflex
3. Muscle wasting

Spinal Cord

Partial	*Hemisection* (Brown Sequard Syndrome)	*Complete*
1 Paresthesia	1 Homolateral weakness (paralysis)	1 Spastic paralysis
2 Weakness	2 Homolateral loss of vibratory and position sense	2 Loss of all sensation
3 Increased deep reflexes	3 Homolateral increase of deep reflexes	3 Loss of urinary and rectal sphincter control
4 Decreased superficial reflexes	4 Homolateral decrease of superficial reflexes	4 Clonic deep reflexes
5 Urinary sphincter disturbance	5 Contralateral loss of pain and thermal sense (light touch preserved)	5 Absent superficial reflexes
6 Decreased pain and thermal sensation (light touch preserved)		6 Babinski and/or Hoffman phenomena
7 Babinski and/or Hoffman phenomena		7 Mass reflexes

Medulla

(All lesions are partial since complete transection is incompatible with life.)

1. Homolateral cranial nerve palsy (or palsies)
2. Homolateral sympathetic signs (Horner's syndrome, absence of sweating)
3. Contralateral paralysis
4. Contralateral loss of sensation (including light touch)
5. Contralateral increased deep reflexes
6. Contralateral absent superficial reflexes
7. Contralateral Babinski and Hoffman
8. Cerebellar signs
9. Respiratory irregularities

(Lesions may be diffusely bilateral rather than unilateral, but the signs given above are a guide to symptomatology.)

Pons

Same as for medulla except the following

1. Signs of increased intracranial pressure frequently

2 Cerebellar signs more common
3 Sympathetic signs less conspicuous

MESENCEPHALON

Symptomatology is protean variable and not subject to schematization except for the following

1 Oculomotor signs
2 Decerebrate rigidity

CEREBELLUM

(Signs may be unilateral or bilateral)

1 Asynergia (failure of antagonist to relax reciprocally with contraction of agonist) In legs these symptoms lead to staggering gait in arms intention tremor and adiadochokinesis in speaking dysarthria
2 Nystagmus (certain areas only)

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CEREBRAL CORTEX

General

1 Disturbance of highest level memory intelligence abstract thought. Minor defects often obscured by positive symptoms evasiveness impulsiveness garrulousness and so on

Frontal Lobe

1 Contralateral pyramidal tract signs
2 Aphasia (chiefly verbal and graphic apraxia) (dominant lobe only)
3 Focal or jacksonian seizures

Temporal Lobe

1 Aphasia (chiefly auditory agnosia and verbal amnesia) (dominant lobe only
2 Contralateral homonymous* hemianopsia
3 Seizures (dreamy spells uncinate attacks)

Parietal Lobe

1 Astereognosis
2 Aphasia (mixed) (dominant lobe only)
3 Seizures (sensory or with sensory aura)

Occipital Lobe

1 Contralateral visual field defect (quadrantic or hemianopsic)
2 Aphasia (visual agnosia) (dominant lobe only)

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* Though homonomous is etymologically correct in this sense popular medica usage is homonymous

3. THE GENERAL SURVEY—I

THE NORMAL STATE

IN THE FOLLOWING chapters examination of the several portions of the body will be described in detail

The student or physician uses four methods of obtaining information about the subject or patient under examination *Inspection* is the method probably of greatest usefulness It is utilized every moment the student is looking at his patient He must train his eye for details to approach the same perfection as does the artist (The use of instruments which may be inserted into passages of the body and the use of the x ray are merely means of extending inspection) *Palpation* utilizes the examiner s sense of touch as he feels or presses upon structures or portions of the body *Percussion* involves striking an area of the body with the fingers or an instrument so that the examiner may listen for sounds produced by the procedure or may feel resistance to the tapping fingers *Auscultation* uses the sense of hearing for the interpretation of sounds produced within the body The instruments which aid in gaining this information are few are relatively inexpensive and may be easily carried in the physician s kit (Fig 1)

Observations of great general interest may be made at the first introduction to the patient Some of these may be made even before any clothing is removed The medical student must train himself in careful observation which should begin the moment he sees the sick person Early in his career he may be startled by snap diagnoses which may be made by the experienced physician With time however if the student is a keen observer, he will come to appreciate that such

Temporal Lobe

1 Aphasia (chiefly auditory agnosia and verbal amnesia) (dominant lobe only)
2 Contralateral homonymous* hemianopsia
3 Seizures (dreamy spells uncinate attacks)

Parietal Lobe

1 Astereognosis
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Occipital Lobe

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* Though homonomous is etymologically correct in this sense popular medical usage is homonymous

state of nutrition the posture assumed and the gait The skin must be included in the general survey also not only because it covers the whole body but also because it not infrequently presents signposts which are the manifestations of internal or systemic disease

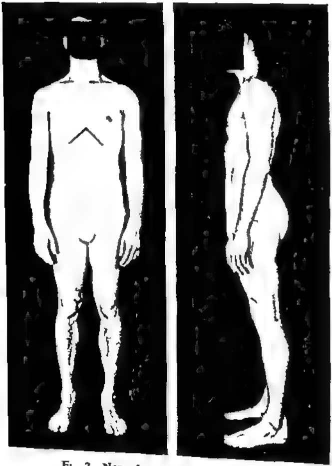

Fig. 2 Normal young man Sthenic type

This comment upon the importance of making observations concerning the skin offers the opportunity to emphasize an admonition which the instructor in physical examination will make over and over again to the student Such an admonition properly appears among

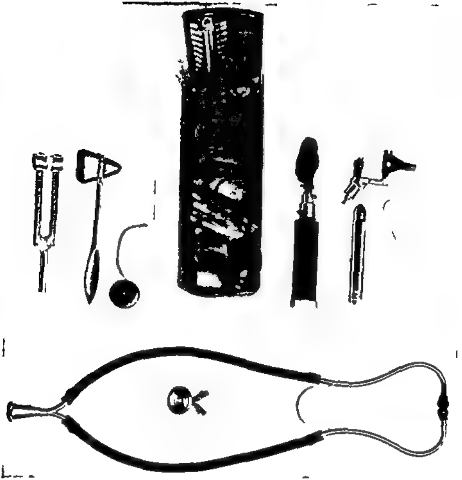

Fig 1 Beginning at left tuning fork for testing vibratory sense percussion hammer mainly for demonstrating tendon reflexes tape measure and flexible ruler for measurements sphygmomanometer for determining blood pressure ophthal moscope for inspection of retina and media of eyeball otoscopic attachment for inspection of aural passages flashlight to provide light for inspection wooden tongue depressors to aid in visualization of mouth and throat Below is stethoscope for auscultation diaphragm chest piece is useful under special circumstances Thermometer and watch adjuncts in examination are in physician s pockets

diagnoses are not made by guess after a superficial examination but by careful observation of essential diagnostic points Edward Jenner (1749 1823) said More mistakes are made by not looking than by not knowing '

Among these general observations, and yet often of great signifi cance, are such points as the patient s constitution, his stature the

Fig 4 Sthenic type Posit on of heart durin, expiration (same subject as in Fig 3)

there is often a clear cut relationship between constitution and disease

Constitution (body build) and stature are thought of as inherited characteristics representing familial types This is essentially true Nevertheless they represent the full influence of the endocrine system As will appear in Chapter 4 in diseases of the glands of internal secretion abnormalities of stature and body build characterize some of these disturbances

The anterior lobe of the pituitary gland is the key unit in the endo crine chain which bears upon constitution and stature Other than for the growth hormone the effects of the anterior pituitary are mediated through its tropic hormones on the target glands the thyroid

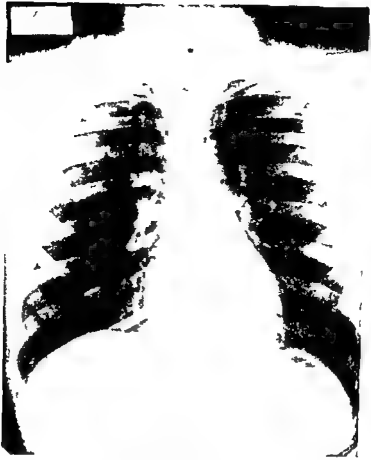

Fig 3 Sthenic type Position of heart during inspiration

the first sentences introducing the student to the technics of examining the patient This essential instruction is that adequate *inspection of the subject or patient can only be carried out in a good light* Only thus may colors, shades of color, and textures of the skin be evaluated A good light brings out or accentuates the shadows on the body surface which permit the observer to note underlying tumefactions pulsations, and movements whether due to respiration the heart or blood vessels, or peristalsis

Constitution and Stature

Body type or constitution is of interest to the physician It has been recognized for years and is being emphasized more and more that

Fig. 6 Hypersthenic type Position of heart during inspiration (compare with Figs 3 and 10)

ment from the latter to the floor should be equal The span of the arms should equal the height

Even the novice recognizes the great variation of body build as between his classmates and acquaintances Most of these can be classified into three or four constitutional or body types or types of habitus

The Sthenic Type The sthenic type (at times spoken of as the athletic type) presents good musculature broad shoulders and a flat abdomen the subcostal angle being a right angle In such a person the face is likely to be of an ovoid configuration and the dental

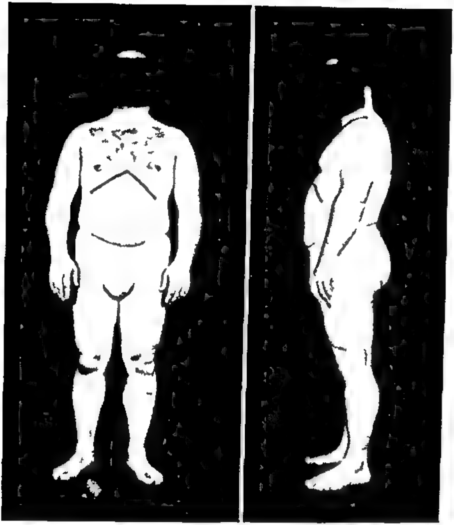

Fig 5 Normal young man Hypersthenic type

adrenal cortex and gonads If the anterior pituitary thyroid and gonadal hormones are normal quantitatively and qualitatively the following should take place The secondary sexual characteristics should develop at twelve or thirteen years of age and the menses in the female should begin at this time The epiphyses will close at the normal age * Though the person may be short or tall the measure ment from the top of the head to the pubic bone and the measure

* Closure of the epiphyses normally is completed usually between the ages of fifteen and seventeen years in females and between the ages of sixteen and eighteen years in males

transverse position the chest is broader and shorter than in the sthenic person and the stomach lies higher in the abdomen (Figs 5 6 7 8 and Fig 3 page 138)

Fig 8 Hypersthenic type High and transverse position of stomach (compare with Fig 12)

The Hyposthenic Type The person of hyposthenic habitus is tall and thin with poorly developed musculature The neck is long the face is triangular in shape and the dental arch is narrow and more pointed than in the sthenic person The abdominal wall often is of poor tone so that it may bulge in the lower portion the subcostal angle is narrower than a right angle an acute angle In the hyposthenic person the heart occupies a more midline position (drop heart)

arch is round but not broad The width and length of the chest and position of the viscera are median between the hypersthenic and hyposthenic (Figs 2, 3, 4 and Fig 2 page 138)

Fig 7 Hypersthenic type Position of heart during expiration (same subject as in Fig 6) (compare with Figs 4 and 11)

The Hypersthenic Type In the hypersthenic build the person is short and stocky, and has a tendency toward obesity The neck is short and thick the face is of the square type, and the dental arch is more nearly square The abdominal wall is thick and the subcostal angle is greater than a right angle, an obtuse angle The heart is in a

transverse position the chest is broader and shorter than in the sthenic person and the stomach lies higher in the abdomen (Figs 5 6 7 8 and Fig 3 page 138)

Fig 8 Hypersthenic type High and transverse position of stomach (compare with Fig 1?)

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than in the sthenic person and the chest is long and flat The abdominal viscera sag toward the lower abdomen (Figs 9 10, 11, 12, 13 and Fig 4 page 138)

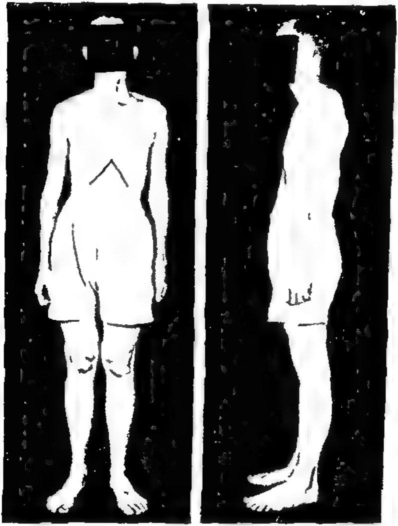


Fig 9 Normal young man Hyposthenic type

The Asthenic Type *The asthenic type presents in general an* exaggeration of the hyposthenic characteristics plus a disproportionately wide and roomy pelvis This permits a greater sagging of the abdominal viscera than occurs in the person of hyposthenic build

Fig. 10 Hyposthenic type Position of heart during inspiration (compare with Figs 3 and 6)

As may be assumed because of generations of intermarriage of the various types the body habitus in some persons may not be so characteristic as to fit into these clear cut categories These may be labelled as *transitional* or *dysplastic* types *

Other m thods of classifying body types are also used The hypersthenic type is spoaken of as *pyknic* or as a *mesomorph* The remainder of persons (except for transitional or unclassifiable ones) are spoken of as *leptosomes* or as *hypermorphs* When the latter terms are used subgrouping is needed—*asthenic* and *athletic* types (hyposthenic asthenic and sthenic respectively as used in this book) The psychiatrist Kretschmer years ago related personality to body types Thus the cyclothyme (pyknic) is characterized by cyclic elation and depression in psyche the *schizothyme* (leptosome) is characterized by the shut in unsocial and introspective personality

Symmetry

Normally the body is quite symmetrical, and a disproportion of some bodily structure is not likely to be encountered However as is quite universally known the bodily symmetry is not perfect

Fig 11 Hyposthenic type Position of heart during expiration (same subject as in Fig 10) (compare with Figs 4 and 7)

Weight and Nutrition

It is hardly necessary to say that weight in the normal person varies greatly as between two individuals, even though sex age, and height are the same It is quite difficult to say where abnormality begins either on the overweight or underweight side The familial factor cannot be overlooked though often this actually may represent

the influence of a household providing good eating Weight tables are available in most textbooks of medicine and represent averages of great numbers of persons of given age sex and height I feel that it is a safe rule to accept a variation of 10 per cent of the person s

Fig 12 Hyposthenic type Low and vertical position of stomach

ideal weight either above or below this figure as within the limits of normal

Though weight is one feature in the nutritional state of a given person it is not all that is implied in good nourishment It includes also the absence of evidence of avitaminosis and hypoproteinemia The tissue turgor and the tone and volume of the skeletal muscle are included in the term of nutrition

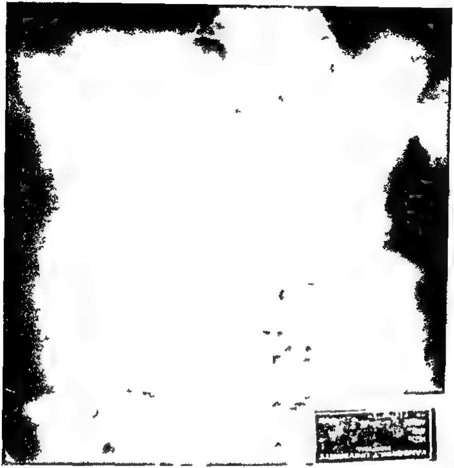


Fig 13 Normal gallbladder lying parallel to fourth and fifth lumbar vertebrae in a hyposthenic person

Posture and Gait

The posture in the normal person is to be considered in the chapter on the skeleton and its appendages (Chapter 18) At this time we are interested in the attitudes the person takes as he walks into the physician's office or as he sits by the desk The attitude or position is also noted as the patient is observed lying in bed Many persons walk erectly others because of poor postural habits, walk into the office in a slovenly fashion with a shuffling gait and round shouldered posture The rapidity or quickness of the step is variable Some persons sit rather tensely or stiffly in the chair others are erect but relaxed, and still others are in a slumped position Normally, or at

least unmodified by disease the person in bed usually lies in a relaxed fashion turning easily without evidence of limited activity

Speech

The consideration of speech falls into an evaluation of the nervous system certain facts however become quite clear as the patient talks to the physician The normal speech habits vary from a slow drawl to sharp incisive enunciation The level of the patient's education is at times manifest in his breadth of vocabulary and method of expressing himself

Psyche

It is important to make note of certain facts while the conversation necessary in obtaining the history is taking place Thus among normal persons the physician will gain impressions of a dull or of a keen intellect of passive acceptance or of active resistance to circumstances The characteristics of passiveness and aggressiveness may be obvious Degrees of emotional stability will be found to vary between persons

Skin

In the general examination the skin must be given careful consideration because here is an extensive expanse upon which or in which may be recorded the manifestations of systemic disease Only some general observations will be made in this chapter upon the results of examination of the skin in the normal person

Pigmentation Exclusive of the color normal to the brown yellow red and black races we recognize two great groups in the white race The dark or brunette persons may vary from the dark almost black color of the Hindu through the swarthiness of the Arab and Syrian as well as of the races of the Mediterranean countries The skin is dark due to a profusion of pigment the iris is brown and the hair tends to be black By contrast the persons of northern European stock commonly are blonde having skins of shades lighter than that of the brunette to skins actually white with little pigment The eyes vary from gray or dark blue to lighter blue and shades of the hair are as diverse as brown flaxen or red The brunette person

responds to exposure to the ultraviolet rays of the sun with increased pigment or tanning, the brown haired, borderline blonde will tan but the true flaxen or red haired, blonde person has insufficient skin pigment to become tanned when exposed to the sun Intermarriage

Fig 14 Chloasma gravidarum Pigmentation during normal pregnancy Forehead and cheeks are most heavily pigmented

for centuries has led to admixtures of skin types so that a pure type may not be obvious in a given person

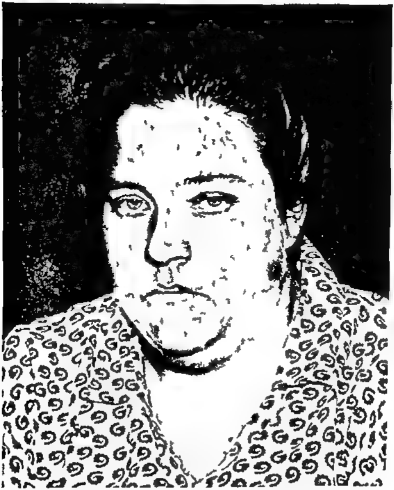
Aside from suntan pigmentation may occur in women as a part of the physiologic process of pregnancy, under the influence of hor monal interrelationships Many women develop a yellowish brown

pigmentation of the forehead cheeks, and neck *chloasma gravidarum* (Fig 14) Universally in pregnancy there is an intensification of the pigmentation of normally pigmented areas such as the nipples and their areolas and also of the genitalia and perineum The chloasma or pigmentation though it may fade after pregnancy, not unusually remains permanently to some degree This is true also of a line of pigmentation which commonly develops in the midline of the abdomen (*linea nigra*) extending from the pubic region to the umbilicus

Texture The texture of the skin is an important guide to the state of health or disease By texture is meant the sense of elasticity and thickness or thinness obtained by picking up a fold of skin between the examining thumb and index finger As the skin of the well nourished healthy young person is examined in this way it will be noted that it quickly returns to its normal contour when released It is felt to be soft or relatively soft With increasing age especially from middle age onward elasticity is gradually lost as elastic fibers in the corium diminish Then as the skin is picked up between the examiner s fingers and released some delay occurs until it reassumes its former level Observation of the skin in a good light reveals from middle age on a more dull appearance and upon body movement the skin is seen to move less smoothly and to wrinkle easily This may become obvious in its earliest stage at the neck especially in women Such an observation indicates physiologic age to a certainty irrespective of the chronologic age given by the patient This change in cutaneous elasticity progresses rapidly after the menopause In the senile person the skin is very inelastic thin or atrophic and parchmentlike

Cleanliness The skin offers evidence of the patient s cleanliness *Body odor* is due to the activity of the sweat and sebaceous glands as well as to uncleanliness In the clean normal person the odor due to the perspiration is variable dependent upon circumstances There may be little or with the excitement and tension of history taking and the physical examination through the attendant vasomotor activity perspiration may increase and the body odor become more pronounced In the presence of uncleanliness the odor is plainly rancid and unpleasant *Dryness* of the skin is related also to some extent to

responds to exposure to the ultraviolet rays of the sun with increased pigment or tanning the brown haired borderline blonde will tan but the true flaxen or red haired blonde person has insufficient skin pigment to become tanned when exposed to the sun Intermarriage



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the skin or mucous membrane results in the transmission of impulses via afferent nerve fibers to the central nervous system The proprioceptive sensations will also be considered briefly at this point The deep sensation or the position sense of joints and muscles and tone of the latter as well as deep muscle tenderness along with vibratory sense, will be considered more fully in Chapter 18 (It is more convenient to test for these sensations and functions at the same time that the deep reflexes are elicited in examination of the extremities) The sensations superficial and deep (proprioceptive) interpret for us our environment The sensory phenomenon of stereognosis is made possible only by an integration of most of these afferent impulses

We are interested now in testing or demonstrating that the sensory end organs and the afferent pathways both peripheral and in the central nervous system are intact or acting normally or that some deviation is present The afferent pathways entering the cord via the dorsal roots may reach the brain through the dorsal columns of the same side or the ventrolateral columns of the opposite side Touch and vibratory as well as proprioceptive sensations travel in the dorsal columns Thermal sensations pain and a portion of the tactile sensations are carried to the brain by the ventrolateral columns (Thus it will be apparent that demon trable sensory disturbances may give a clue to the localization of disease in the central *nervous system*) Sensory impulses originating in the skin and mucous membrane of the head are carried via the trigeminal and glossopharyngeal nerves *

Actually the testing of the cutaneous sensations light touch pain temperature and pressure are frequently very unsatisfactory and extremely difficult of critical evaluation This should be quite obvious to the reader since it involves a subjective type of examination To be sure the infant and the psychotic or unconscious patient may respond reflexly to a painful stimulus (the pin prick or a hot object) by withdrawing the foot or other part stimulated thereby proving that pain sensory tracts are intact However the mapping out of areas of decreased or increased cutaneous sensation requires an attentive and cooperative subject Checking and rechecking cutaneous patterns of

* The student is referred to his textbooks on physiology for the details of the physiologic mechanism involved in the domain of sensory perception and to Chapter 7 page 28

the activity of the sebaceous glands as well as to the sweat glands The dryness or moisture of the skin varies with the environmental temperature *and humidity In the presence of an elevated* temperature and humidity, body heat is dispersed in part by the evaporation of perspiration resulting from increased sweat gland activity—thus the moist skin In cold weather, the reverse is true and the skin is therefore dry

Color The *color* of the normal skin in terms of redness' "pinkness, or 'pallor," is dependent upon the capillary bed, its depth in the skin, and capillary dilatation at the time There are some blonde persons who appear pale with normal hemoglobin levels, others with the same level appear almost plethoric because of dilated superficial capillaries Heat and embarrassment cause blushing or redness due to capillary dilatation Blanching of the skin occurs normally upon exposure to cold, and in anger or fright as the result of constriction of the cutaneous capillaries

Warmth or *coldness* of the skin is likewise related to capillary dilatation or constriction and varies in the normal person with the temperature of the environment and the emotional state at the moment

Cherry (senile) angiomas are bright red sharply localized, flat or slightly raised areas several millimeters in diameter seen with increasing frequency as age progresses They may be seen not infrequently in the teens and twenties but are present in all persons beyond seventy Nothing is known of their significance nothing suggests that they denote disease

Hair Since hair is an appendage of the skin consideration may be given here to some details concerning it Among the normal variations one may expect to find a heavier distribution of body hair in brunette than in blonde persons especially in the male in whom the beard in particular is heavier and grows more rapidly Pubic and axillary hair is expected to appear normally at the time of puberty, at the age of eleven to thirteen years With attainment of middle age the body hair begins to thin out in most persons especially in males This is true in all portions of the body the scalp beard pubic hair and body hair possibly owing to changes in the hormonal balance of middle age especially as related to the gonads

Sensory Examination The stimulation of receptor end organs in

closed should show little unsteadiness of *gait* Coordination in the upper extremities is determined by the finger to finger or finger to nose test in the lower extremities a similar test may be carried out by having the subject place the heel of one foot on the other knee and slowly move it down the shin to the foot (See Chapter 18 page 644)

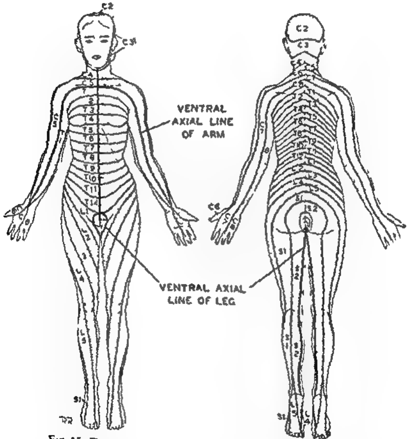

Fig 15 Dermatome pattern of body (Keegan J J and Garrett F D Anat. Rec 102 409 1948)

The intact *position* sense permits the subject to identify not only the toe the examiner is manipulating but also to recognize the direction or movement *Deep pain sense* makes the subject conscious of firm and prolonged pressure upon a muscle or the pain present on pinching a tendon (commonly the Achilles tendon) (pages 37 38)

disturbed sensation are tiresome, especially to patients who are quite ill and therefore the results of the examination are often open to question Only *consistently demonstrable sensory abnormalities upon several examinations may be acceptable* During the testing of cutaneous sensations the patient's face should be so screened that he cannot see the examiner's hands nor the part of his body being examined

The epicritic or superficial sensory phenomenon of *light touch* may be tested by a wisp of cotton or by a small brush Tactile sensation is not prominent over thick skin such as that of the soles of the feet (page 37)

The sense of *pressure* is noted if a blunt object is pressed upon the skin to the point of indenting it It is different from superficial tactile sensation, since it may be present even though the sense of light touch is lost

Pain sense is tested by the use of the point of a pin or needle Light pressure must be used so that the patient does not misinterpret pressure sense as that of pain To be certain that the difference between a painful sensation and one of pressure or touch is properly recognized the following method of testing may be carried out The subject's skin may be lightly pricked with the pin point one or several times and then the pinhead may be applied lightly The patient is asked to name the sensations induced as sharp or dull respectively (Pain sense may be tested also by tugging on the hair) (pages 37 38)

The *thermal* sense is tested with small test tubes containing warm or cool water *Excessively cold or hot tubes when applied to the skin give rise to painful sensations and not thermal ones* The temperatures suggested are 64° and 104° F (18° and 40° C) respectively (page 38)

The *proprioceptive* or *deep sensations* provide the afferent impulses which permit the recognition of position direction of movement and sense of deep pressure These collectively aid in the evaluation of objects as to form weight and size Coordination of movements is dependent upon the proprioceptive sensations and may be tested as will appear in more detail in Chapter 18 *Station* may be tested by having the subject stand erect without shoes feet together either with the eyes open or closed and should reveal no more than slight swaying in the normal person Likewise walking with the eyes

figure is not uncommon The temperature of the environment unless extreme usually influences the body temperature little, since the heat regulating mechanism maintains a homothermal state (Heat is conserved by capillary constriction or lost by capillary dilatation and attendant physiologic phenomena)

The temperature may be most accurately determined by rectum a method commonly used in the case of infants This is usually 0 7 to 0 9° F higher than the oral temperature There may be wider differences in normal persons Oral temperatures may be as much as 2 0° F lower than rectal temperatures and in occasional persons the oral temperature may be slightly higher In the presence of high fever the differences between rectal and oral temperatures are less The axilla also may be used for the determination of body temperature worth while only if the axilla is sufficiently moist to exclude air and to permit close apposition of the skin to the thermometer bulb The temperature level is usually about one to two degrees lower by axilla than by mouth In taking oral or rectal temperatures the thermometer should be left in place for at least three minutes In the former the bulb should be under the tongue and the mouth closed (The ingestion of hot or cold fluid or food immediately before the oral temperature is determined may lead to erroneous results) For axillary recording the thermometer must be held with the upper arm closely pressed to the chest wall for at least five minutes

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Two point discrimination involves simultaneously touching adjacent areas of the skin by points of a compass to learn whether the subject recognizes the stimulus as being single or double Normally, it varies with the profusion of the tactile end organs The points of a compass used in this test must be blunted to eliminate painful stimuli On the leg 3 or 4 cm is the narrowest range within which a double stimulus is recognized as such Over the back, it is still greater On the palm of the hand two point discrimination is accurate within 1 cm, and on the tongue within 1 to 2 mm

Vibratory Sense By the use of a vibrating tuning fork applied on a bony prominence a normal subject recognizes the vibration and its cessation (Chapter 18 pages 37 38)

Stereognosis Stereognosis is the ability of the subject to identify by touch alone an object placed in his hand an object which he may move between his fingers Only when the peripheral sensory mechanisms are intact does this represent a test of cortical function Objects such as coins buttons keys and the like may be used (page 40)

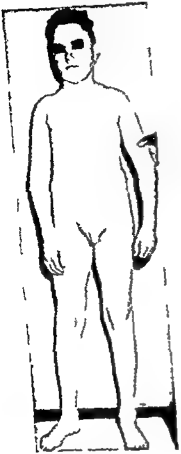
By applying the above technics to any portion of the body the examiner may attempt to map out areas in which the sensations of touch pressure temperature pain and proprioception are abnormal in contrast to normal areas The areas so mapped then are related to the segmental or peripheral nerves carrying the sensations from the corresponding dermatomes For such localization a chart like that in Fig 15 is essential *

Temperature

A valuable barometer of disease at times is the level of the body temperature ** The figure of 98 6° F (37° C) is quoted usually as being that of normal mouth temperature However in the normal person one must allow for some fluctuation In the early morning upon awakening the basal temperature may be as low as 97° F (36 1° C) It then usually rises gradually during the day to reach 99° or 99 2° F (37 3° C) in the latter part of the afternoon The latter

* At the present time Keegan s work on the arrangement of the sensory nerve supply or the dermatomes is receiving wide acceptance in this country It is superseding the older arrangements accepted in the past

** Thermometers may be inaccurate This is especially true of cheap ones Only instruments certified as tested by prescribed standards should be used



Fg 1

Fig 2

Fg 1 Infant lism due to cran opharyng oma Eighteen year-old male height 53 inches lack ng body hair and having undescended right test cle

Fig 2 Marfa s d sease in twenty-e ght year-old woman illustrative of eu nucho d bod ly disproportion though development of secondary sexual charac ter st cs was delayed only sl ghtly

eunuchoidism is used to describe the person with a disproportionately greater lower body measurement genital underdevelopment but with obesity due to possible hypofunction of the posterior lobe of the pitui tary or to a suprasellar tumor If this occurs in prepubertal hypo gonadism in the male the body configuration approaches the feminine type the obesity being related to hips and breasts

4. THE GENERAL SURVEY—2

FINDINGS IN DISEASE

CONSTITUTION AND STATURE

Stature and Habitus Stature and habitus are influenced by mal *function of the anterior lobe of the pituitary gland through its growth* hormone as well as through the gonadotropic thyrotropic and adreno corticotropic hormones In Chapter 3 I described the bodily propor tions and the development of the secondary sexual characteristics at twelve or thirteen years of age as they occur under normal hormonal balance

A slight variation from the normal is the short stocky person in whom though the pituitary growth hormone is normal, there is an earlier *gonadal function in terms of sexual development and closure* of the epiphyses due to precocious activity of the gonadotropic hor mone Thus the lower body measurement is shorter than the upper and the arm span is less than the height

Infantilism means the maintenance of the childlike state beyond puberty in terms of the secondary sexual characteristics indicative of abnormal interhormonal relationships (Fig 1)

Eunuchoidism This term is usually descriptive of a skeletal dis proportion in which the lower body measurement is greater than the upper, and the arm span is greater than the height There is usually associated delay in sexual development including delayed menses However *the skeletal disproportion may be present with normal sexual* development the gonadotropic hormone being of the normal amount or quality The fingers are long and slender (Fig 2) The term obese

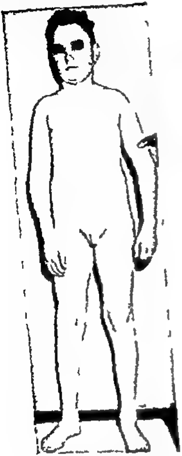


Fig 1

Fig 2

Fig 1 Infantilism due to craniopharyngioma Eighteen year-old male height 53 inches lacking body hair and having undescended right testicle
Fig. 2 Marfan's disease in twenty-eight year-old woman illustrative of eunuchoid bodily disproportion though development of secondary sexual characteristics was delayed only slightly

eunuchoidism is used to describe the person with a disproportionately greater lower body measurement genital underdevelopment but with obesity due to possible hypofunction of the posterior lobe of the pituitary or to a suprasellar tumor If this occurs in prepubertal hypogonadism in the male the body configuration approaches the feminine type the obesity being related to hips and breast

Pituitary Dwarfism Pituitary dwarfism results from hypofunction of the anterior lobe, producing a uniformly arrested development The proportions of the body segments are relatively normal, but there is

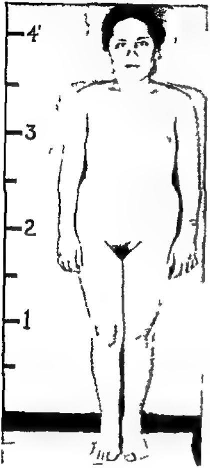


Fig 3

Fig 4

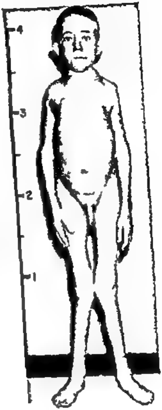
Fig 3 Pituitary dwarfism in twenty six year old woman with amenorrhea Body measurements lower body 68 6 cm (27 inches) upper body 67 3 cm (26½ inches) arm span 1 37 meters (54 inches)

Fig 4 Progeria in pituitary dwarf twenty six year-old woman (wrinkled face suggests older age)

a failure of development of the secondary sexual characteristics · The person is actually a well proportioned *small* woman or man (Fig 3) Such persons not infrequently appear prematurely aged this condition is known as *progeria* (Fig 4)

Gigantism This results from hyperactivity of the anterior pituitary

lobe and obviously the abnormal growth must occur before the epiphyses close (It is due usually to an eosinophilic adenoma) Werner divides these into normal gigantism and eunuchoid types



F g 5 Fig 6

Fig 5 Gigantism in twenty two year old woman Body measurements lower body 87 9 cm (38 2 inches) upper body 82 7 cm (36½ inches) arm span 187 9 cm (74 inches)

Fig 6 Renal dwarfism (renal osteodystrophy) and infantilism in twenty-one year-old man There had been chronic renal disease since childhood

(Fig 5) In the former the upper and lower body measurements are equal and the arm span equals the height The eunuchoid giant has a greater lower body measurement than upper the arm span is greater than the height *Acromegalic gigantism* may result from a tumor of the pituitary gland which appears after adolescence but

before the epiphyses close, such cases show the characteristics of acromegaly, as seen in the adult type, plus gigantism (The circus giant is of this type)

Fig 7

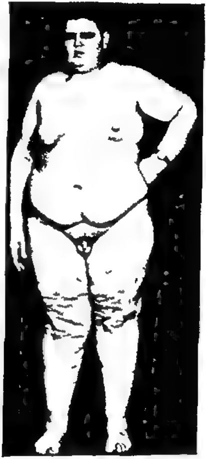


Fig 8

Fig 7 Hypopituitarism (chromophobe adenoma) in thirty three year-old *man Loss of sexual libido loss of beard and axillary and pubic hair*

Fig 8 Dystrophia adiposogenitalis of Frohlich in twenty year-old male

Dwarfism of Other and Unknown Causes In addition to dwarfism due to pituitary and thyroid hypofunction abnormal stature may result from other causes

The true proportionate dwarf, or midget of the circus has a *primary dwarfism* of unknown cause though a hereditary factor plays a part The body is of normal though diminutive proportions, with or without *infantilism* (The term ateleiosis is applied to these

persons at times though incorrectly so because this implies infantilism) The epiphyses do not close and therefore growth may occur in later years

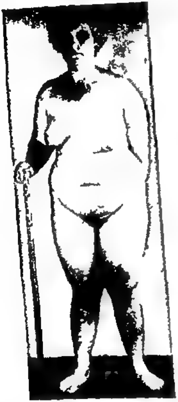


Fig 9

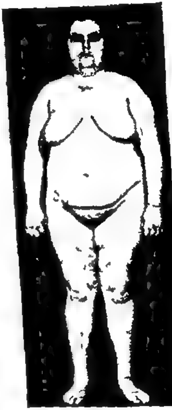


Fig 10

Fig 9 Dystrophia adiposogenitalis of Frohlich in sixteen year-old girl accompanied by irregular and scanty menses of five years duration and amenorrhea of one year s duration

Fig 10 Pituitary basophilism in twenty three year old woman Obesity of face and trunk beard and striae are present

Chronic disease of nutritional infectious cardiac or metabolic origin in childhood may be reflected in stunted growth or dwarfism This is manifested as *disproportionate dwarfism* (Fig 6) *Renal dwarfism* results from profound disturbances in mineral metabolism in chronic kidney disease

Dwarfism may occur also from malformations of the osteochondral structures The best example is the premature union of the epiphysis and diaphysis, resulting in short extremities in contrast to a normal trunk—the *achondroplastic dwarf* The soft bones of *rickets* permit

Fig 11

Fig 12

Fig 11 Hyperpituitarism Patient as he appeared at eighteen years of age
Fig 12 Hyperpituitarism (same patient as in Fig 11) Appearance at forty nine years of age (See Fig 28 page 680)

bowing of the long bones with a resultant shortened stature A description of these and allied abnormalities will appear in Chapter 19

Marfan s Disease This results from a rare congenital disturbance of the mesenchyme of unknown cause It is associated usually with

disproportionately long extremities, resulting in the eunuchoid type of body build. The long fingers and toes give rise to the descriptive term of arachnodactyly (Fig 2)

Bodily Conformation In addition to the effect of pituitary functional abnormalities which have their reflection in stature and interrelationships of the body parts there are others resulting in certain body conformations and in attendant sexual abnormalities

Hypopituitarism (Chromophobe Adenoma)* In adult life this may cause adiposity of a feminine distribution in males In males the beard is lost and the pubic hair arrangement becomes that of the female pattern or may be lost (Fig 7) In females the menses cease

Pituitary Basophilism (Cushing's Syndrome Basophilic Adenoma) This condition is characterized by fat deposits in the face neck and trunk with purplish striae appearing on the abdomen and thighs (Fig 10) Kyphosis of the spine is usual Hirsutism appears in females and there is loss of the beard in males Hypertension is common The basophilic cellular activity is definitely related to the hormones of the adrenal glands Tumors of the adrenal glands produce a similar picture It seems therefore that the findings in this syndrome result from adrenocortical effect whether intrinsic or initiated by a basophilic adenoma of the pituitary

Hyperpituitarism (Acromegaly Eosinophilic Adenoma) Here there is a coarsening of the facial features and enlargement of the body as a whole (Figs 11 12) This results from an overgrowth of

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* *Dystrophia adiposogenitalis of Frohlich* is a name given a condition occurring in both sexes in adolescence in which obesity is found associated with a delay of puberty (Figs 8 9) Both sexes show a fat distribution of the feminine type of the breast buttocks and thighs The hands are usually *small* *In both* sexes the secondary sexual characteristics are underdeveloped In males the beard and axillary and pubic hair are sparse The genitalia are small and the testicles often are imperfectly descended In females the axillary and pubic hair is sparse The breasts though containing much fat may have little breast tissue The external genitalia as well as the uterus are small and the menses may be delayed

Though a few instances of chromophobe adenomas and other diseases of the hypophysis or suprasellar region have been described in certain of these cases the condition is too common to be universally associated with such disease Furthermore the abnormalities often correct themselves later in the teens with weight loss and normal development of the secondary sexual characteristics Endocrinologists at present have not found out the dysfunction or hypofunction which may account for this There is much question whether the nomenclature of dystrophia adiposogenitalis of Frohlich should be used unless an actual lesion of the pituitary gland or adjacent area is established

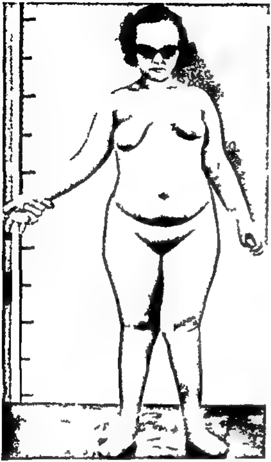


Fig 13 Laurence Moon Biedl syndrome in eleven year old girl Deafness partial blindness obesity with abdominal striae and precocious sexual development

Fig 15 Cretinism in twenty-one ye old woman Complete lack of second sexual characteristics

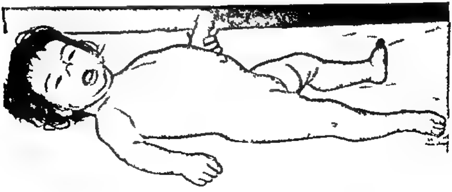


Fig 14 Cretinism in four year old girl

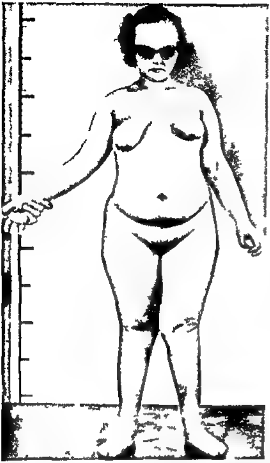
Fig 16 Myxedema in sixty five year old woman before treatment

Fig 17 Myxedema (same patient as in Fig 16) after treatment with thyroid gland substance

the flat and short bones There is also splanchnomegaly an over growth of muscles and the subcutaneous tissues—structures of meso dermal origin The hands in their enlargement become spadelike (Fig 28 page 680)

Laurence Moon Biedl Syndrome This syndrome of familial origin is rare and originally was thought to be of pituitary origin Now however it is thought to be related to a lesion in the floor of the midbrain It is characterized by obesity mental deficiency genital dystrophy retinitis pigmentosa deficient skeletal and muscular devel opment and at times polydactylism (Fig 13)

Hypogonadism Hypogonadism in males produces a feminine con tour of the body with fat deposits in the breasts and at the hips The beard is sparse and the crinis pubis is of the female type Castra tion before puberty permits abnormal body growth of the eunuchoid disproportion because of delayed closure of the epiphyses The genitalia remain infantile In female castrates hypogonadism is mani



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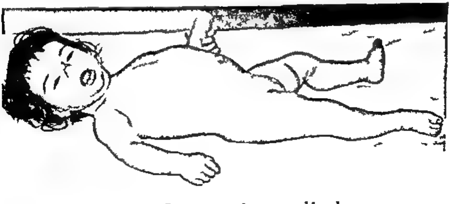


Fig 14 Cretinism in four year old girl

Fig 20 Total asymmetry involving bones as shown by x ray films (From Charity Hospital New Orleans Kampmeier R H J Nerv & Ment Dis 84 187 1936)

apathy the characteristic dull expression with thick lips and large tongue and thickening of the subcutaneous tissue will probably be noted (Fig 14) He is potbellied The extremities are short in relation to the trunk because the bony growth is retarded As untreated cretinism continues beyond puberty there is an absence of

Fig 18

Fig 19

Fig 18 Adrenal cortical hyperfunction in five year-old boy having growth of ten year old boy (Pubic hair appeared at five months of age masturbation at two years adult size external genitalia at four years No adrenal tumor found at operation)

Fig 19 Endocrinopathy in twenty three year old man Feminine breasts and pattern of pubic hair male sexual libido genital anomalies (See Fig 5 page 594)

fested in a thinning of the pubic hair increasing adiposity of the breasts and by a trochanteric type of fat distribution at the hips *Hypo ovarianism* at puberty (as by castration) and thereafter is accompanied by underdevelopment of the breasts and the sexual organs The body will develop into the masculine type

Hypothyroidism In the congenital or infantile form, this is manifested as *cretinism* The child is a dwarf and an imbecile, though the degree varies within wide limits Within a few months of birth

Weight and Nutrition

Obesity Excess weight is in most instances due to a caloric intake greater than that needed by the person for his basal plus work requirements Overindulgence is due either to habit or to psychologic maladjustment In the obesity of an excess food intake unmodified by

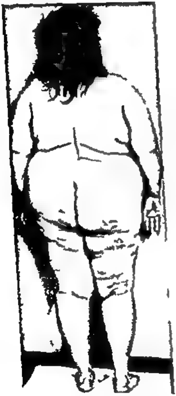


Fig 21

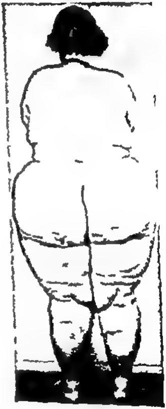


Fig 22

Fig 21 Obesity due to overeating
Fig 22 Obesity of type thought to be due to hypopituitarism

endocrine disease the fat deposit is of general distribution (Fig 21) So called "endogenous obesity attributed by many authors to disease of the endocrine glands represents only an excess of calories in one whose requirement is less than before the endocrinologic change Thus the castrated person may gain weight because of lessened

development of the secondary sexual characteristics such as pubic and axillary hair, the menses are not established and the breasts remain infantile (Fig 15) In the *myxedema* of adult life the thickening of the subcutaneous tissue produces a puffy appearing face and there is hair loss an apathetic expression and obesity as described on page 168 (Figs 16, 17)

Adrenocortical Hyperfunction This condition may give rise to *marked symptoms of a generalized nature (Rarely is tumor the cause more often no anatomical change is found in the gland)* The abnormalities are mainly manifested in the sex organs and in the secondary sexual characteristics If present before birth a tumor produces *pseudohermaphrodism* and *precocious puberty* in the infant Most cases of cortical hyperfunction occur in girls, and when it occurs in childhood or late childhood there will be masculinization with growth of facial and axillary hair, and a male pattern of pubic hair *Menses will be absent and the genitalia become hypertrophied* the labia enlarge and the clitoris enlarges to simulate a small penis In male children there is precocious development of a beard appearance of axillary and pubic hair, and enlargement of the genitalia (Fig 18) In adult women, adrenocortical hyperfunction leads to excessive growth of hair on the body as well as on the face with a male pattern of pubic hair * The menses cease the breasts atrophy and the clitoris hypertrophies to project from between the labia (Fig 40, page 619)

Much is still to be learned about endocrinopathies Mixed clinical pictures may be encountered which cannot be classified (Fig 19)

Asymmetry As noted in the general examination (page 52) asymmetry usually will be related to certain parts of the body, such as the face, an extremity or the chest These will be considered under their appropriate headings Rarely will total hemiatrophy of the body be found in which one side of the body in all its parts shows diminution in size (Fig 20) It is postulated that this may occur in a brain stem lesion

* Recently a clinical entity characterized by abnormalities of ovarian function and hirsutism and associated with a specific lesion of the ovary has become known as the Stein Leventhal syndrome

may be described It is alleged by some that fat deposition about the shoulder girdle resulting in large breasts and large upper arms and about the pelvic girdle as shown by large hips and buttocks is characteristic of hypopituitary obesity (Fig 22) Such persons are

Fig 25

Fig 26

Fig 25 Pituitary cachexia in twenty six year-old man Fibrosis of pituitary gland was shown at necropsy

Fig 26 Hypopituitarism typical of Sheehan's disease (hemorrhage into the pituitary gland at parturition) Weight loss does not reach emaciation Loss of pubic hair is evident

supposed characteristically to show absence of fat deposits in the lower portions of both the upper and lower extremities they are described as being tapered The face is said to be uninvolved also With a decrease or absence of activity of the gonads (*hypogonadism*)

activity (This is confirmed by the fact that caloric restriction causes weight loss as predicted, even though there is disease in the endocrine system)

Fig 23

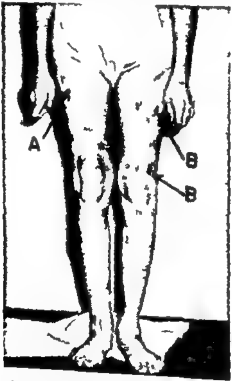
Fig 24

Fig 23 Lipodystrophia progressiva in thirty nine year-old woman having its onset at age six following accident Little subcutaneous fat of face shoulder girdle and thorax

Fig 24 Emaciation due to starvation accompanying esophageal carcinoma

As was indicated above obesity results only from a relative excess intake of food Clinicians in general do not accept so called 'endogenous obesity as an entity For the sake of completeness, the Frohlich type of obesity was mentioned in the footnote on page 71 For the same reason, at this point, the so called 'adult pituitary obesity

Abnormalities of Fat Deposit of Unknown Origin *Adiposis dolorosa* (Dercum s disease) a rare disease of unknown cause and occurring more often in women than in men is characterized by irregular painful fat deposits over the whole body Again of unknown etiology is *lipodystrophia progressiva* characterized by a loss of fat in the upper portion of the body with its maintenance in the lower portion The face may appear emaciated (Fig 23)



Fi 30 Nonsuppurative pann cul t s *A* Areas of infiltration *B* Depress ons due to atrophy

Loss of Weight Weight loss of greatest extent is seen most often in chronic infections or malignant disease The subcutaneous tissue is lost the muscles lose volume and the bony landmarks become increasingly prominent The extremes of emaciation are seen in carcinoma of the esophagus where *starvation* is an added feature (Fig 24) Obstruction anywhere in the upper gastrointestinal tract may lead to

as after castration or after the menopause, obesity often develops characterized by a fat deposit over the trochanteric region of the hips and by an increased amount of fat in the breasts at the mons veneris and in the abdominal wall

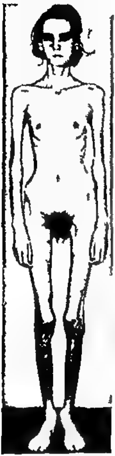


Fig 27

Fig 28

Fig 29

Fig 27 Anorexia nervosa in eighteen year-old woman before treatment
Fig 28 Anorexia nervosa (same as in Fig 27) after treatment
Fig 29 Malnutrition and loss of secondary sexual characteristics due to chronic hookworm infection in twenty-one year old woman

In *hypothyroidism* or hypofunction of the thyroid hormone basal requirements are decreased and fat is deposited generally including the face and the whole of the extremities In disease of the *adrenal glands* in children a rare and unusual obesity of the upper portion of the body may occur A generalized obesity may follow encephalitis at times

merely by chance He will find that the patient with acute pleuritis prefers to lie on the affected side in order to decrease painful respiratory movements The patient with cardiac failure especially that due to mitral stenosis finds it more comfortable to sleep with his head on his folded arms sitting at a table or bedside stand because of better gas exchange The asthmatic person or the one with pulmonary edema prefers to sit upright especially because of the better excursions of the diaphragm In the presence of peritoneal inflammation the patient finds it more comfortable to have the knees drawn up in order to decrease intra abdominal tension

Fig 31 Retraction of head in cerebrospinal meningitis

In cerebrospinal meningitis the retraction of the head resulting from meningeal irritation may be so extreme that the patient can lie only on his side (Fig 31) Similarly the *opisthotonos* or spasm of the paravertebral muscles in tetanus may be such that the patient s body is supported only upon the heels and the retracted head

Gait The gait may be diagnostic That of the *tabetic* patient is often to be recognized on the street Having lost the function of the posterior columns of his spinal cord with or without the aid of canes the patient walks with a broad base watching the ground he lifts his feet relatively high and brings them to the ground with a flail like or slapping movement (page 38)

starvation A rare disease, characterized by extreme emaciation and due *to the complete destruction of the pituitary gland* is that known as "pituitary cachexia' (Simmonds disease) (Fig 25) At times it is difficult to differentiate this from the emaciation seen occasionally in maladjusted young females known as 'anorexia nervosa" (Figs 27, 28) Emaciation is not necessarily characteristic of all instances of destruction of the pituitary gland Hemorrhagic destruction of the pituitary at child birth is usually not followed by cachexia (Fig 26) Chronic disease undermining the patient s nutrition may lead to widespread systemic effects as in the case shown in Fig 29 This patient suffered from chronic hookworm infection With malnutrition there was weight loss, the menses ceased, and the secondary sex characteristics were lost

Localized Loss of Fat This may occur occasionally as the result of hypersensitivity to insulin Following localized reactions in the subcutaneous fat after injections of insulin atrophic areas develop *Relapsing nonsuppurative panniculitis,* a rare disease of unknown cause is characterized by localized red swellings due to inflammation of the subcutaneous fat Subsequent depressions may appear in the skin due to atrophy of the underlying fat (Fig 30)

As was noted in Chapter 3 nutrition is not only a matter of weight Vitamin deficiency iron lack and other less common elements have their physical manifestations These do not fall into this general survey except certain ones to be noted under discussion of the skin on page 119 Others will be pointed out in the sections on certain of the anatomic regions

Posture and Gait

Certain of the postures and gaits having to do with purely local disease such as wry neck or the limp of a shortened leg due to poliomyelitis, will be discussed under the appropriate sections Here it will be indicated that certain postures or gaits may give the diagnostic clue to diseases of more generalized or systemic nature Therefore the student should attempt to develop his powers of observation and to make note of these points

Posture At the bedside the student will quickly recognize that a patient may be propped up in bed because of breathlessness and not

32) Occasionally there is a forward propulsion in small steps so that the patient almost runs and stops only by falling or voluntarily running against a wall to come to a stop and thus to regain his equilibrium This is called festination (page 39)

A *spastic gait* follows injury to the upper motor neurone The person who has suffered a stroke or other accident to the motor cortex or its radiations with residual *hemiplegia* walks usually with the arm held flexed at the elbow and pronated in walking the lower extremity is circumducted at the hip with plantar flexion and inversion of the foot so that the great toe describes an arc as it scrapes along the ground (Fig 33 pages 38 39)

The person with *paraplegia* due to spastic adductor muscles of the thigh has a characteristic scissor s gait the thighs tending to override each other In disease invading the equilibrium mechanism of the central nervous system the patient reels like a drunken person

SPEECH

As the history is being taken the speech especially when considered with the psyche may give important diagnostic clues The tense anxious person is likely to speak rapidly at a higher pitch this also may be true of the thyrotoxic patient and it is even more marked in the patient suffering from a manic psychosis The speech is slow halting and with a few if any inflections (monotonous) in the person suffering from marked hypothyroidism from paralysis agitans or in a depressive psychosis The person showing the effects of chronic alcoholism or of general paresis may have a hesitant speech commonly it is slurred so that enunciation is not clear This can be accentuated or demonstrated by having the patient repeat certain test phrases containing recurring consonants such as Methodist Episcopal or third riding artillery brigade (page 39)

The speech associated with obstruction in the nasopharynx is muffled because of the lack of the normal effect of the sinuses acting as resonators The student reader will recognize this most commonly in his classmate who has nasal congestion due to a cold The huskiness or hoarseness of laryngeal disease again will be recollected as part of a cold or upper respiratory tract infection This is

Fig 32

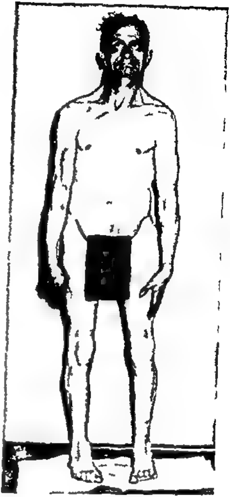


Fig 33

Fig 32 Stance and gait due to parkinsonism Posture is stooped head held rigidly hands held at sides not swinging with walking and gait is shuffling

Fig 33 Stance due to spastic hemiplegia resulting from birth injury Spastic muscles of right side are visible Right lower extremity is adducted foot is turned inward

Even commoner is the *parkinsonian gait* of basal ganglion disease usually of arteriosclerotic or postinfluenzal encephalitic origin The typical picture results from anteflexion which is manifested by a stooped posture arms held flexed at the elbows flexion of the meta carpophalangeal joints and of the knees The characteristic position of the hands accompanied by a rhythmic alternating tremor is com monly described as pill rolling The gait is slow and shuffling (Fig

delusions and hallucinations quickly point to psychosis or intoxication (Toxic substances may be of endogenous origin as in uremia or of exogenous nature as drugs) Mania or overactivity and its opposite depression or apathy quickly become obvious The euphoric or ill considered happy mood of certain psychoses may be noted as in some instances of general paresis for example The lack of proper emotional reactions and the detached air of the schizophrenic patient are characteristic Most common of all however will be encountered the emotional instability of the overanxious maladjusted psychoneurotic patient Emotional lability is quite characteristic of hyperthyroidism in contrast to the apathy of myxedema

Skin

In Chapter 3 it was indicated that certain observations should be made concerning the skin in the general survey of the patient Here comments will be made concerning cutaneous abnormalities and the use of descriptive terms without formally discussing dermatologic disorders

Texture The texture of the skin is often most important and even diagnostic in certain systemic diseases Weight loss and dehydration will result in a dry skin and one that has lost elasticity It falls back slowly after being pinched or picked up With greater degrees of weight loss a tuck can actually be taken as it is picked up In *hyperthyroidism* because of the capillary dilatation for the promotion of heat loss the skin feels smooth and silky and is moist, warm and elastic If such a skin is encountered in males in whom a less fine skin is anticipated it is very suggestive of *thyrotoxicosis* On the other hand in *hypothyroidism* and *myxedema* varying degrees of dryness and inelasticity *are expected* because of the decreased blood supply and the myxomatous subcutaneous tissue The skin is cool and lacks perspiration

The *skin of scleroderma* is somewhat atrophic is stretched tightly over bony prominences and is inelastic In extreme degrees the inelasticity may be of such extent that movements of the joints and of the face are impeded (Figs 34 35) In diseases accompanied by a disturbance in the trophic nerve supply and thus with vasomotor

Fig 34 Generalized scleroderma resulting in immobility of face and joints of hands

owing to edema or inflammation of the vocal cords Persistent hoarseness suggests tumor or paralytic disease of the vocal cords *

Psyche

As in the case of speech so the patient s psyche also as observed at the time of history taking may provide valuable information Disorientation wandering in the train of thought confabulation

* Cough might be considered at this point as an observation made often at the time of history taking It may be a sign of serious systemic disease or of lesser organic disease (More discussion will be given this subject in Chapter 11) Here it should be noted that both huskiness of the voice and a short cough like that of clearing the throat are not uncommonly signs of emotional tension

Fig 36 Ichthyosis

cleanly hyperpigmentation may be marked at sites of pressure as at the belt line

Color The color of the skin is highly important in systemic disease as well as in skin disease itself Though as was pointed out in Chapter 3 *pallor* cannot be used as a certain guide to anemia it is nevertheless a finding that may be suggestive This is especially true if a yellowish tint is present—an indefinite sort of color described as sallow yet very arresting to the experienced eye This is very characteristic of the chronically ill person whether caused by chronic infection malignancy or leukemia

Redness or increased pinkness of the skin due to capillary dilatation is noted in fever and as the result of burns localized or generalized after exposure to radiant heat the ultraviolet rays of sunlight

Fig 35 Localized scleroderma of left side of chin and forehead and scalp

changes, the skin may become thinner and lose its normal elasticity in terms of the usual degree of wrinkling appearing as taut parchmentlike tissue This is seen at its best and commonly over the fingers in persons suffering from *rheumatoid* or *deforming arthritis*

In the rare familial disease of absence of sweat glands (*anhidrosis*) the skin is dry in familial *ichthyosis* the dry inelastic skin is characterized by extreme scaly desquamation (Fig 36)

Uncleanliness This condition is usually quite obvious Prolonged lack of bathing may lead to a more or less permanent discoloration of the skin due to pigmentation Possibly it is related to scratching especially if infestation with body lice and/or the parasites of scabies has been present—the so called "vagabond s disease In the un

than in those of blonde complexion because of the greater profusion of pigment in the deeper layers of the skin

Pigmentation due to the irritation of *physical agents* is not uncommon Though suntan from ultraviolet rays fades after the summer season repeated deep tanning year after year leads to some degree of permanent pigmentation The same may occur after x ray therapy

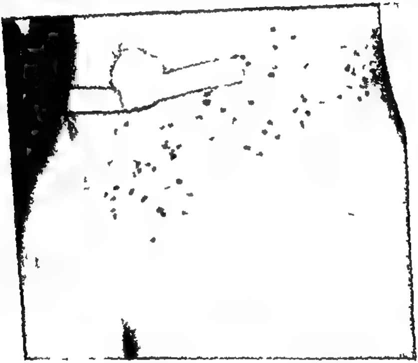


Fig 37 Pigmentation accompanying neurofibromatosis.

The most common cause of permanent tanning due to a physica agent is prolonged or repeated burning by heat rays (*erythema ab igne*) with resultant increased pigment deposit in healing Th repeated use of a hot water bottle or heating pad on some area of th body leads to an identical mottled brown pigment deposit Simila pigmentation is seen commonly among those persons spending muc time sitting close to a stove or especially in front of an open grat fire The skin on the anterior surface of the legs presents a mottle or marbled appearance due to melanin deposit (Fig 4 page 155) I

or to exposure to the x ray in treatment In localized areas of inflammation, the increased blood supply accounts for the redness as seen over a furuncle, an abscess, or over an inflamed joint The dusky redness or bluish red color, of *anoxemia* is common in some types of cardiorespiratory disease due to anoxia, and/or compensating *polycythemia* It is often diagnostic In the rare instances of *polycythemia vera* there is a generalized redness of the skin Duskiness of the skin may occur in *methemoglobinemia* occasionally encountered as the result of the use of coal tar derivatives such as acetanilid Rare examples occur from the wearing of recently dyed shoes

Under the above mentioned circumstances, the capillaries are either in the normal state of patency or in a state of dilatation and/or patent in greater numbers By contrast, the capillary bed may be constricted

Pallor of the skin, other than in anemia, may be related to vasomotor phenomena, as is seen in the vasoconstriction of shock attended by cold, clammy perspiration The dead white color of the frostbitten skin is due to capillary closure Primary vasomotor disease of the extremities will be discussed in Chapter 19

Blood and *bile pigments* may give color to the skin In *pernicious* (macrocytic) *anemia* the patient may appear to be not only pale but to have in addition a faint yellow tint, spoken of as "lemon yellow" indicative of the hemolytic element (bilirubinemia) in this anemia In mild degrees of *jaundice* as in intrahepatic disease or in early obstructive jaundice the bile pigment imparts a yellow color to the skin as well as to all other tissues except to those of the teeth and the central nervous system This deepens with increasing jaundice to a golden yellow in well established obstruction of the common duct it assumes a greenish yellow tint, later to approach the color of ripe olives

In *carotenemia* resulting from the excessive intake of foods rich in carotene the skin is of a tint approaching an orange color This is seen at its best in the palms

Pigmentation Pigmentation of the skin may be localized following local skin changes as the result of disease or prolonged irritation It may be localized or general owing to disease of systemic origin Pigmentation always will be more intense in those of brunette

Fig 39 Vitiligo of unknown cause

race because of the lusterless appearance the pigmentation of this disease looks as if soot has been rubbed on the skin

A curious pigment deposit of localized patches of yellowish brown pigment with or without darker freckles may involve the skin supplied by nerves involved in *neurofibromatosis* (Fig 37)

Pigmentation accompanying *endocrinopathy* occurs in a number of conditions The most dramatic is that associated with *Addison s disease* This may suggest the diffuse tanning from exposure to sun light usually more intense over the exposed parts because of the added factor of the sun s rays However it differs from suntan in that the pigmentary deposit may be accentuated especially over pressure areas as at the elbows and buttocks The palmar creases

the winter months, there may be evident overtones of red, representing the erythema of current or recent exposure to heat

Just as pigment deposit occurs as a protective mechanism following exposure to ultraviolet light, heat waves or the x ray, so, too it accompanies or follows chemical burns, the fixed dermatitis due to drugs inflammations of infectious origins and certain skin disorders

Fig 38 Pigmentation of Addison s disease on face upper neck laterally and at V of neck Black freckles are present on forehead

of unknown cause Such pigmentation may be permanent or temporary, of weeks or months duration and obviously dependent upon the degree of stimulation of the pigment cells of the skin Repeated *trauma may lead to pigmentation* especially if infection accompanies it Thus the multiple small, pigmented areas following repeated hypodermic injections may suggest drug addiction

Hyperpigmentation This follows or accompanies the inflammation and desquamation of the dermatitis of *niacin deficiency* (Figs 59 and 61 and Fig 14 and 47 pages 600 and 625) It may become almost black and is seen best over exposed surfaces that is the face neck, hands and forearms though it may also appear on the genitalia and perineum areas of normally increased pigmentation In the Negro

stances The best known but now of lesser frequency than in the past is *argyria* due to the deposition of silver salts it occurs commonly from the prolonged use of organic silver preparations such as nasal drops which are swallowed The silver is deposited in the deeper layers of the skin which gradually assumes a slate gray color varying

Fig 41 Xanthomatosis of skin in diabetes mellitus

from a faint to a true dark slate color Over the exposed areas of the skin it is likely to be intensified and over the forehead especially the skin presents in a good light an almost metallic sheen * In rare instances in the patient having had prolonged treatment with *bismuth salts* given parenterally a bluish pigmentation of splotchy distribution may develop This is most likely to be found in the skin about the mouth The pigments introduced in *tattooing* are so obvious as to need mention only Bluish punctate pigmentation similar to tattoo marks results from *coal dust* being introduced into the skin with

* A rarely seen diffuse melanosis accompanying malignant meloma but highly suggestive of argyria in its color

may appear as dark brown lines Furthermore it is often marked in areas *normally hyperpigmented, as in the axillas* in the areolas of the nipples, and about the genitalia and perineum Commonly, there are accompanying *black* freckles on the face arms neck, and back, as

Fig 40 Localized depigmentation following butterfly inflammatory lesion of discoid lupus

well as pigmentation of the mucosae to be described elsewhere in this book (Fig 38) Less often in *thyrotoxicosis* a faint brown pigmentation may occur on the body also accentuated in exposed areas In *ovarian disease* pigmentation may be found much as in pregnancy as described in Chapter 3

Rare forms of pigmentation occur as the result of extraneous sub

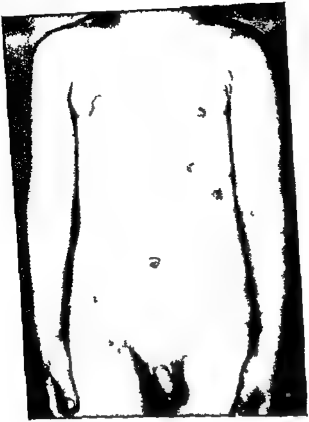


Fig 43 Macular lesions of ringworm

Lipoid Diseases In disturbances of lipoid metabolism an accumulation of lipoids may appear locally as yellowish plaques or tumors in the skin known as xanthomas The primary type are due to hypercholesteremia they may be secondary to uncontrolled diabetes mellitus In Hand Schuller Christian's disease a familial trait xanthomas are of the normocholesteremic type There are cases of unknown cause (Figs 41 42)

Scars Scars on the skin are often helpful in diagnosis The most obvious are those due to injury and to operations The latter may give valuable information The McBurney scar presumably indicates a former appendectomy and thus rules out appendicitis as the cause of pain in a given case The ragged scar in the right upper quadrant suggests prolonged drainage of the gallbladder instead of its removal

Fig 42 Xanthomatous plaques and tumors of unknown cause

injury it is often seen in coal miners, and in railroad firemen and engineers *Gunpowder* burns produce such tattooing also

Hemochromatosis (bronze diabetes) is an example of endogenous pigmentation of metallic origin. Owing to a poorly understood ab normality of iron metabolism hemosiderin and hemofuscin are de posited in the skin as well as in other tissues causing a bronze shade For no known reason mild diffuse pigmentation may accompany chronic liver disease (*portal cirrhosis*)

Depigmentation As the reverse of hyperpigmentation there may be a disturbance of normal pigment deposits in terms of lessened amounts Thus there is the rare condition of congenital *albinism* in which there is a complete deficiency of pigment If this occurs in patches it is known as leukoderma The acquired loss of pigment is known as vitiligo' This occurs commonly and appears as a sym metrical, patchy lesion of a white or purplish color The cause is unknown but it must be related to the trophic nerve supply in some way because of the symmetrical involvement (Fig 39) Certain inflammatory lesions involving the deeper layers of the skin and thus the pigment cells may be followed by depigmented areas (Fig 40) Patchy depigmentation is often accompanied by patchy graying of the hair Few readers will see examples of the anesthetic depigmented lesions of *leprosy*

Fig 45 Papules of erythema multiforme on skin and lips (note annular lesion on left hand)

the rapidly enlarging breasts have striae radiating from the areolas When the striae heal they remain as white scars the skin is thin in these areas and is easily wrinkled

Pinpoint or pinhead size scars over the veins in the antecubital fossa suggest previous *intravenous medication* or narcotic addiction most commonly heroin Similar multiple scars elsewhere may mark the site of *subcutaneous injections* of drugs in the addict or of insulin in the diabetic patient

Bites The possibility of bites by insects snakes or animals should always attract attention because of their possible relationship to a number of systemic diseases Tick borne diseases offer several examples Ratbite fever is an example of the transmission of disease by the bite of an animal (Fig 64) Such trauma as the portal of entry of the infectious agent in systemic disease is well illustrated in instances of tularemia Ulceration may mark the site of the bite by insect snake or animal

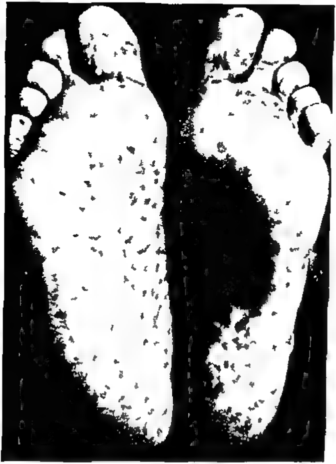


Fig 44 Papular lesions of secondary syphilis

The traumatic or surgical scar remains pink for six to eight months and then turns white

A rapid gain of weight stretches the subcutaneous tissue so that the epidermis is thinned permitting the more vascular subepidermal tissue to show its color Thus reddish blue irregular linear areas 2 5 cm or more long and 6 to 12 mm in width are evident In rapidly developing obesity and in Cushing s disease these *striae* appear about the shoulders, on the lateral aspects of the abdomen and on the thighs the long axes of the lines paralleling the long axis of the body (see Fig 10) In pregnancy striae are common on the sides of the abdomen in the later months of pregnancy, and often

Fig 48 Papules and pustules of acne

Fig 49 Pustular rash

Fig 46 Papules due to leukemic infiltration of skin (case of monocytic leukemia)

Fig 47 Vesicular rash of herpes zoster

Fig 5? Metastatic melanosarcoma

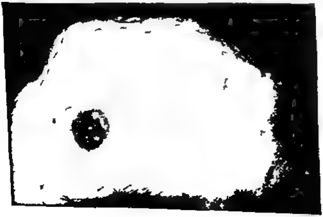


Fig 53 Basal-cell carcinoma

Fig 50 Nodular rash of erythema nodosum

Fig 51 Pigmented nevus

Fig 52 Metastatic melanosarcoma

Fig [illegible] Basal cell carcinoma

Fig 54 Leukemia cutis

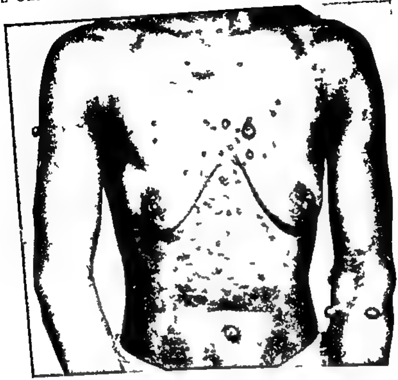


Fig 55 Neurofibromatosis

Morphology of Skin Lesions Though no dermatologic disease as such will be discussed or described in this book a definition mus be given of the terms used to describe skin lesions of whateve etiology—whether inflammatory metabolic allergic due to contac with an irritating substance or due to the internal use of drugs Thes common terms are used daily by the physican as he records the ex amination of his patients *

Primary Morphologic Lesions

MACULE A spot of discoloration of the skin but not raised abo its surface (Fig 43)

* The definitions have been modified from Taber s Cyclopedic Medical Dictiona F A Davis Company Philadelphia and the American Illustrated Medical Diction by W A Newman Dorland and E C L Miller W B Saunders Co with the k permission of the publishers

Fig 56 Carcinomas in xeroderma pigmentosa

PAPULE A small solid, elevated area of the skin up to several millimeters in diameter, with or without an alteration of color (Figs 44–46)

VESICLE (BLISTER) A small sac containing serum and elevated above the skin level (Figs 47 59)

PUSTULE A small cavity of pus in an elevated area of the skin (Figs 48 49) (This may develop as a change from serum to pus in a vesicle or may result from necrosis in a papule)

NODULE A large papule of probably more than 0 5 cm in diameter (Figs 50–56) (The term tubercle is used by some in the same manner)

TUMOR An inflammatory or neoplastic mass in the skin larger than a nodule (Figs 52–56)

Fig 57 *A* Blebs *B* Bullae *C* Ulcers and crusts (Eruption due to drug)

BLEB A serum containing sac larger than a vesicle (Figs 57 59)

BULLA A large blister or bleb (Figs 57 59)

PLAQUE A term used to describe a plateau like localized elevation of the skin (Figs 41 42)

WHEAL A pink or white elevated plaque or ridge due to intercellular fluid accumulations in the corium (Fig 58)

INDURATION A term used to describe localized or generalized thickening of the skin (Fig 59)

ERYTHEMA This represents widespread redness developing as such or resulting from confluence of red macules (Fig 59)

Secondary Changes As the result of these primary morphologic lesions secondary changes may be noted and described

SCALE The desquamation of dead epithelium in a thickened visible fragment This is greater than the powdery normal desquamation and usually appears on the surface of papules nodules or indurated areas (Figs 60–62)

Fig 58 Urticarial wheals

Fig 59 Pellagra Surfaces exposed to light show erythema pigmentation induration vesicles blebs and bullae

Fig 60 Diffuse desquamation due to arsenical exfoliative dermatitis

Fig 58 Urticarial wheals

Fig. 6? Thick scales on papular and nodular lesions of Boeck's sarcoid

Fig 61 Localized desquamation in healing pellagra (pigmentation is present at borders)

EXCORIATION, OR ABRASION This represents an area denuded of superficial epithelium, usually due to scratching or removal of adherent scales

CRUST This consists of serum or blood coagulated upon the surface of an excoriation or abrasion or at the site of a ruptured vesicle or bulla (Fig 57)

FISSURE A crack in the skin of such depth as to penetrate through the epidermis

VERRUCA A wartlike change often engrafted upon a papule in which the epithelium develops excrescences—as a verrucous papule (Fig 63)

Fig 65 Ulcers of blastomycosis

Fig 66 Ulcers and tumors due to sporotrichosis

Fig 63 Verruca (wart) on forehead

Fig 64 Ulcer due to rat bite (case of rat bite fever)

Fig 65 Ulcers of blastomycosis

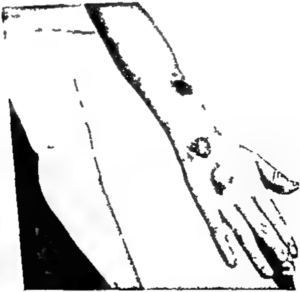


Fig 66 Ulcers and tumors due to sporotrichosis

Fig 67 Atrophic scars of upper arm and face following gummatous syphilids

Fig. 68 Keloid formation

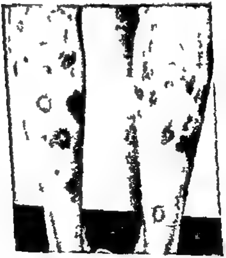


Fig. 69 Pigmentation following papular eruption

Fig 70 Petechiae in purpura haemorrhagica Ecchymoses are present in groins

ULCER An open sore due to necrosis and loss of tissue in the skin penetrating to a variable depth (Figs 64—66)

SCAR An accumulation of connective tissue replacing the loss of tissue due to inflammation burn trauma or ulceration Scars may be thin or atrophic (Fig 67) or at the opposite extreme may become elevated as the result of fibroblastic proliferation This is known as keloid formation found especially in the Negro race (Fig 68)

PIGMENTATION The intensification of melanin at the site of former skin lesions Its presence gives a clue of the depth to which the reaction occurs in a skin disease Lack of subsequent pigmentation indicates superficial cutaneous involvement whereas pigmentation means that involvement of the deeper cell layers of the epidermis had taken place (Fig 69)

Fig 71 Senile keratoses of cheeks (note arcus senilis in corneas)

Fig 72 Hyperkeratosis at hair follicles due to vitamin A deficiency

HEMORRHAGE Hemorrhage into the skin often is significant The most common cause is a contusion or bruise with bleeding, and later a 'black-and blue spot' due to residual blood pigment However, a bleeding tendency is characteristic of certain systemic diseases and is of great importance

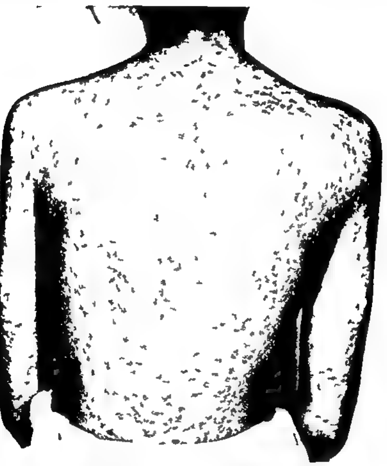


Fig 73 Follicular rash with some hyperkeratosis due to syphilis

Petechiae are hemorrhagic areas a millimeter or so in diameter due to capillary bleeding as the result either of *embolism* as in subacute bacterial endocarditis or of *bacterial conglomerations and infection* as in meningococcic staphylococcic or streptococcic septicemias and the like Bleeding into the skin also occurs both in *thrombopenic purpura* and in the *symptomatic purpura* of scurvy leukemia hepatic

disease and a variety of infections The bleeding may appear as *petechiae* or if in larger areas of several millimeters in diameter may be described as purpuric spots The term ecchymosis is used to describe still larger hemorrhagic areas (Fig 70)

KERATOSIS Keratosis describes the piling up of the epidermis into callosities plaques wartlike structures or horns One such response

Fig 74 Spider angiomas

to irritation or friction is seen on the palms of a laborer s hands Keratoses are common in blonde senile patients On the covered areas of the skin they tend to be soft On the exposed skin of the face and hands they are hard dry and at times horny (Fig 71) They are important for they commonly provide sites for the development of *epitheliomas* Occasionally one may note a sandpaperlike skin especially on the upper arms and thighs owing to *hyperkeratosis* at the hair follicles as the result of a piling up of the superficial keratinized epidermal cells This is characteristic of vitamin A deficiency (Fig 72) Generalized extremely pruritic follicular hyperkeratosis

occasionally occurs in secondary syphilis in the Negro race only (Fig 73)

BLOOD VESSELS Blood vessels of the skin may give the clue at times to important or serious internal disease The veins become prominent with loss of subcutaneous tissue and with loss of skin

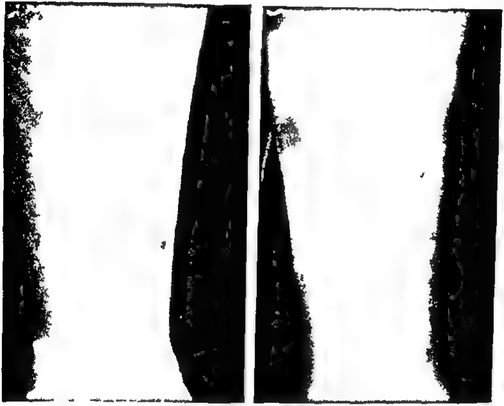


Fig 75 *A* Venous star *B* Infrared photograph of same star showing varicose veins

elasticity Thus they provide evidence of weight loss As will be shown in subsequent chapters the development of a *collateral venous circulation* over the chest or abdomen may point to mediastinal disease or disturbances in the vena caval and portal circulations (Chapters 11 13 15) *Spider angiomas* most commonly are found upon the face, and about the neck shoulders, and upper chest The spider consists of a central end artery with radiating smaller vessels It is caused by an excess of 17 ketosteroid hormones at times in pregnancy, or in liver disease which interferes with their

metabolism (Fig 74) *Venous stars* consist of dilated venules and may simulate the spider angioma but more often appear as a telangiectatic mat or lattice work They signify high pressure in superficial veins or in large veins as the vena cavae they may be seen in the legs during pregnancy (Fig 75)

Fig 76 Dermatographism

DERMATOGRAPHISM This is the response of the skin to irritation such as stroking it with the finger nail or other dull instrument The pattern is outlined by elevated ridges on the skin at the lines of irritation—white or pink in color (Fig 76) It is of the same nature as the wheal representing edema of the corium due to increased capillary permeability or injury possibly related to histamine Dermatographism

is most often demonstrated in nervous persons and illustrates in stability of the vasomotor system It appears in persons suffering from urticaria

EDEMA Edema of the skin indicates an accumulation of inter cellular fluid in the subcutaneous tissue It may be caused by in creased venous pressure as in congestive heart failure or by obstruc tion to the venous or lymphatic return as by tumors or inflammation

Fig 77 Edema of legs and feet demonstrated by pitting upon pressure (arrows indicate less obvious areas in addition to prominent one above ankle)

In electrolyte imbalance as found in nephritis in decreased osmotic pressure resulting from the loss of serum albumin as in nephrosis or in the hypoproteinemia of starvation fluid also may collect under and in the skin Edema is accentuated in dependent parts because of gravity It may be demonstrated by pressure on the skin which displaces the fluid leaving a pit—so called pitting edema In high grades of edema the skin is stretched taut so that it is shiny (Fig 77) Rupture of the skin with oozing fissures may actually

take place under such circumstances After subsidence of the edema, the overstretched skin is found to be wrinkled and inelastic Such skin may be accepted as evidence of past edema Though recent edema is soft long continued edema is characterized by an accompanying induration and pigmentation at times and is described as brawny

Fig 78 Alopecia totalis of unknown cause

SUBCUTANEOUS EMPHYSEMA Subcutaneous emphysema will be described under the chapters on the chest and neck since it usually is encountered in these parts

From the foregoing paragraphs it is apparent that the skin in many instances reflects *systemic disease* The reader will note that the examples which have been used to illustrate the morphology of skin lesions have been with few exceptions those due to systemic disease and not skin diseases *per se*

Hair Abnormalities of the hair of the scalp and of the pubis will be discussed in following chapters Nevertheless from a general view point a few comments should be made

Premature *graying* is usually a familial characteristic of unknown cause The graying associated with vitiligo was noted above (see page 96)

Generalized thinning of the hair is characteristic of myxedema Complete loss of hair *alopecia totalis* occurs rarely (Figs 78, 79) There is no known explanation for this, but it probably represents an endocrine abnormality at times it is permanent and in other instances

Fig 79 Alopecia totalis (same patient as in Fig 78)

the hair may grow out again Occasionally, hair loss occurs after high fevers and in starvation owing to poor nutrition of the hair papillae

Hirsutism or abnormal growth of hair is found more often in women in whom it takes the form of a generalized growth of hair as well as of a beard and a masculine pattern of pubic hair Such an unusual finding occurs due to cortico adrenal tumors and to arrheno blastoma of the ovary and in the Stein Leventhal syndrome but often is due to nondemonstrable causes (Fig 80)

Fig 80 Hirsutism including beard in twenty-one year-old woman Its onset was simultaneous with menarche (No adrenal tumor found at operation)

SENSORY FINDINGS IN DISEASE

The testing of sensation has been described in Chapter 3 (Again it should be emphasized that any sensory deficit encountered should be confirmed on repeated examination) Sensation may be accentuated in irritative lesions (*hyperesthesia*) it may be decreased below normal (*hypesthesia*) or it may be completely lost (*anesthesia*) (pages 37 38)

In involvement of the dorsal root notable most commonly in diseases of the vertebral column and in tabes dorsalis there may be increased sensitivity to touch pain and temperature in the dermatome supplied by the respective root or a decrease of these sensations to their complete absence In the presence of disease of the posterior columns of the cord there is interference with the proprioceptive and vibratory sensations and functions (pages 37 38)

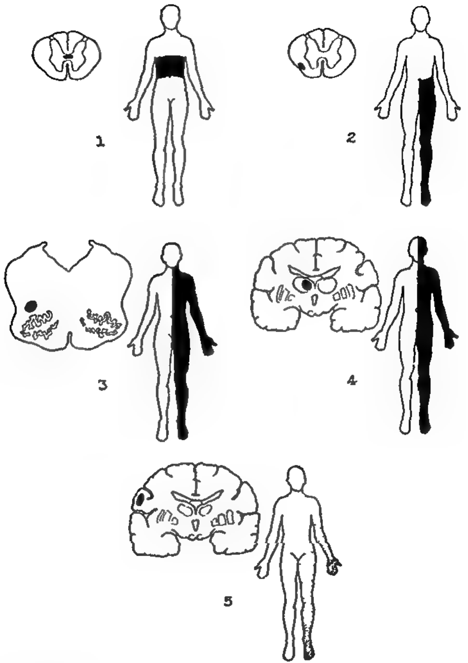


Fig 81 Sensory disturbance patterns *1* Commissural *2* spinothalamic tract in cord *3* spinothalamic tract in medulla *4* thalamus *5* sensory cortex (Alpers B J Clinical Neurology F A Davis Co)

If the peripheral nerve is functionless because of neuritis (infectious or toxic), sensory disturbances may be partial or complete (If the nerve is severed the sensory loss is of course complete) In the area of the body supplied by the nerve the sensations of pain temperature touch vibration and position will be affected

In the presence of lesions of the central gray matter of the spinal cord as in tumor syringomyelia and the like the decussation of fibers carrying pain and thermal sensations may be affected as they cross to the ventrolateral columns Obviously such sensory disturbance may be bilateral for a given cord segment or segments (Fig 81)

In involvement of the spinothalamic tract in the ventrolateral part of the spinal cord the sensory disturbance will be in the field of thermal and pain sensation of the opposite side of the body (see Chapter 3) Inflammatory degenerative and neoplastic diseases of the cord may be the cause of such changes (page 38)

Hemisection of the cord produces the so called Brown Sequard syndrome' On the side of the lesion in addition to paralysis there is a loss of vibratory sense and a loss of position sense with ataxia On the contralateral side there is loss of thermal and pain sense

If the function of the cord is completely interrupted by trauma or by disease as inflammation vascular disease degenerative disease or tumor there is obviously complete paralysis of all sensory as well as all motor and sphincter activity below the level of the lesion The upper portion of this level may show a zone of hyperesthesia (page 38)

Thalamic lesions of one side if complete are accompanied by a complete loss of all sensation from the whole half of the body (including the face) opposite to the lesion There is also astereognosis

Disease of the sensory parietal cortex may also be accompanied by disturbances in sensation The loss of position sense is usually complete and commonly the same is true of vibratory sensation Touch pain and thermal senses are either unaffected or equivocally so The sensations involving discrimination such as two point evaluation texture weight and stereognosis are seriously impaired

Astereognosis or the inability to recognize objects placed in the subject s hands is indicative of a lack of integration of sensory impressions reaching the cortex This was discussed in the preceding chapter (page 40)

In psychoneurosis (hysteria), the patient often complains of paresthesia or numbness in an extremity This may be accompanied by a loss of superficial touch and of pain sensations Characteristically these are recognized by the lack of anatomic reference Commonly such anesthesia is of the glove or stocking distribution without higher involvement of the respective dermatomes

Body Temperature

Abnormalities of the body temperature are most commonly those of an elevation above the normal level Less often does the physician encounter subnormal temperatures

Subnormal Temperatures Subnormal temperatures of below 97° F (36 1° C) may be found in such acute circumstances as shock of whatever cause, in sudden severe hemorrhage and just preceding or during a chill as the result of vasoconstriction Temperature levels below normal may be found in such chronic states as myxedema (owing to the low level of heat production) in the anoxemia of heart or pulmonary disease, in severe states of exhaustion and after prolonged exposure to low environmental temperatures Rarely the temperature may be markedly subnormal in an overwhelming malarial infection—the so called algid type

Fever Fever or elevation of the body temperature, may be of varying degrees ranging from 99 5° F (37 4° C) to 108° or even 110° F (43° C) The latter values are found but rarely and are designated as hyperpyrexia The variability of fever is dependent upon several factors the two most important being the severity of the pathologic process and the individual reaction of the host or patient to the disease For example children have a very labile heat regulating mechanism and may respond to a mild infection with *several degrees of fever whereas a similar infection* in an adult might raise the temperature only a degree Again two adults with pneumonia of apparently the same extent may vary several degrees in their febrile response to the infection

Commonly, fever is a response to local or general infections with many types of infectious agents—bacteria viruses, rickettsias protozoa, and fungi The second most common cause of fever is *malignancy*, especially when widespread or when there is necrosis in the

tumor Thus any type of carcinoma or sarcoma may be associated with fever this is especially true in lymphomatous diseases such as Hodgkin s disease and the leukemias Split products of proteins absorbed within the body may be the cause of fever as in the absorption from a large *hemorrhage* into a serous lined cavity or into the intestine similarly fever accompanies tissue death as that occurring in pulmonary or myocardial *infarction* The injection of *foreign proteins* into the body likewise may cause fever as is well illustrated in the use of vaccines sera and the like

In *dehydration* as the result of an inadequate volume of circulating medium heat dissipation is impaired and fever may result Hyperpyrexia with temperatures of 106° F (41° C) or more may be encountered in *heat stroke* Paralysis of the *heat regulating center* may occur as the result of increased intracranial pressure or of local disease in the brain stem and the temperature may reach even to 110° F (43° C) A similar paralysis of the heat center may also take place in the so called thyroid storm or "crisis of severe thyrotoxicosis

Fever is accompanied by certain clear cut physiologic changes in the body The *pulse rate* usually increases about 10 beats per minute for each degree of fever partially to supply the increased blood flow needed for the dispersion of heat through the skin and lungs (This may not be true in increased intracranial pressure in meningitis or in typhoid fever) For each degree of fever the *respiratory rate* will be increased by about 2 cycles per minute In acute pulmonary disease such as pneumonia the respiratory rate may be increased still more in relation to the fever because of the added factor of oxygen lack Also for each degree of fever the *basal metabolic rate* will increase about 7 per cent

In addition to these physiologic changes other observations may be made Usually even to the unpracticed eye the patient appears to be sick He often is restless but may be somnolent or drowsy, delirium may be present or stupor or even coma Sweating is often present if there is a downward trend of the fever

Fever may have an insidious onset rising gradually over a period of days this is seen often in typhoid fever four or five days being required to reach 104° or 105° F (40° or 40 5° C) At the op

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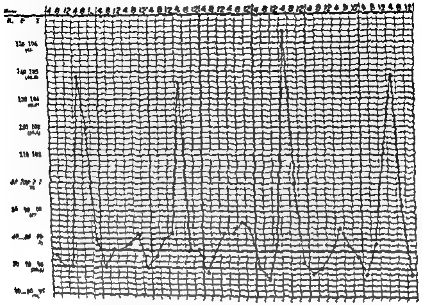

Fig 84 Intermittent fever (tertian malaria)

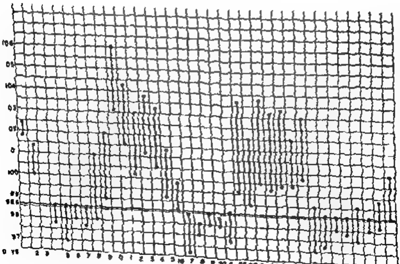

Fig 85 Recurring fever (Hodgkin's disease)

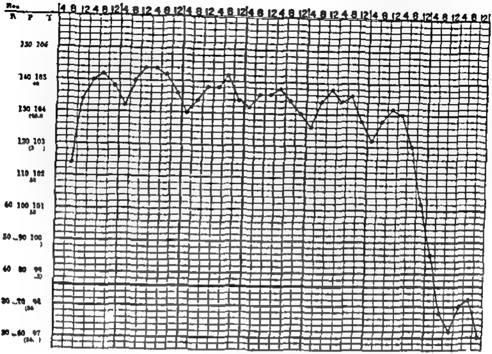

Fig 82 Continuous fever ending in crisis (lobar pneumonia)

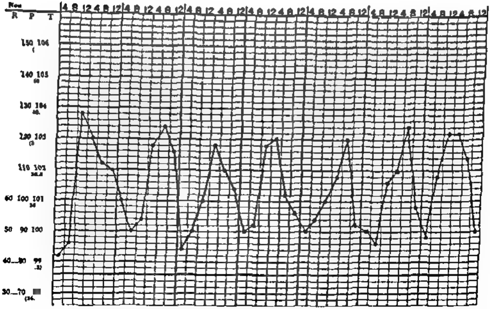

Fig 83 Remittent fever (pulmonary tuberculosis)

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posite extreme, is an abrupt onset often observed in lobar pneumonia a temperature of 105° or 106° F (40 5° or 41° C) being reached within an hour or two Fever may decline slowly, a week or more being required for the temperature to become normal, this is described as 'lysis," and is well illustrated in typhoid fever If the cessation of fever is abrupt, dropping from 105° F (40 5° C) for example, to a subnormal level of 96 5° F (35 8° C) at times, as seen in some cases of lobar pneumonia the fever is said to terminate by "crisis

Kinds of Fever *Continuous fever* is one in which the temperature curve is maintained at an almost constant level with fluctuations within the day of only 1 to 1 5 degrees (Fig 82) This type is present in many of the prolonged infectious diseases, such as typhoid fever

Remittent fever presents a temperature curve with daily fluctua tion of more than 2 degrees, the low point in the day approaching but not reaching the normal level The *fastigium* or height, may be at any level of from 102° to 106° F (38 6° to 41° C) Such curves are found in pulmonary tuberculosis, Hodgkin s disease and coccal septicemias (Fig 83)

Intermittent fever is one in which the temperature drops to normal or below normal and then reaches its former height again This is well illustrated in malaria (Fig 84)

Recurring fever is a term describing a course as follows After a febrile period the temperature drops to a normal level, remaining there for some days and then rising again This may represent a relapse of the disease Such a fever is encountered at times in brucel losis and as the Pel Ebstein fever of Hodgkin s disease (Fig 85)

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encountered in the examination of the skull or scalp The *bregma* is the area at the junction of the sagittal and coronal sutures In many normal persons a slight depression is noticeable at this area—the former site of the anterior fontanel The *vertex* is the summit or high point of the cranium The meeting point of the sagittal and lambdoid sutures is named the *lambda* This site of the former posterior fontanel may be marked in the normal subject by either a depression or a slight protuberance Of further assistance in the localization of lesions of skull or scalp is the designation of areas by the underlying bones that is frontal temporal parietal occipital and mastoid

Fontanels These are found to be open normally for the first twelve to eighteen months of life in the case of the anterior, and the first six to eighteen months for the posterior fontanel

Scalp and Hair

The *color* of the hair plays a part in the classification of the subject as being of the brunette or blonde type *Graying* of the hair commonly begins after forty or fifty years of age though some persons escape this even in extreme old age Whitening or *canities* occurs because of the disappearance of pigment and the presence of air between the cells of the cortex Premature graying is not infrequent and is often familial the cause being unknown Similarly a localized patch of gray or white hair may be a family trait

Alopecia (baldness) often occurs in males (rarely in women) in middle life This is rarely total occurring usually over the vertex or top of the head It is caused by death of hair follicle cells or atrophy though why this should occur in such a clear cut distribution is unknown There seems to be some evidence that it is related to changes in the male hormone Premature baldness may be a familial finding again of unknown cause

Ears

The size of the ears and their degree of protrusion vary greatly from person to person Slight asymmetry may be noted between the two ears in a given subject Some persons show the *darwinian tubercle* at the helix of the pinna or auricle (Fig 1) this anomaly must be

5. THE HEAD—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

IN THE EXAMINATION of the head a definite plan should be followed Logically, inspection and palpation of the skull, scalp and hair are the first examinations to be carried out Then the face and its component parts should be carefully inspected and portions may be palpated Finally, the mouth and its structures are studied Inspection and palpation are the two methods of examination employed almost to the exclusion of percussion or auscultation. The two latter technics may be utilized occasionally as will be shown in Chapter 6

SKULL

Contour The contour of the skull varies greatly within normal limits and bears a definite relationship to the race of the individual The elongated skulls are classified as *dolichocephalic* the rounder ones as *brachycephalic* These forms in their extreme types are seen in some of the more primitive peoples Between these are the *mesaticephalic* skulls of the mixed races European Chinese and the like

Size Just as the contour of the skull in normal persons varies greatly, so also does the size of the cranium The *megacephalic* skulls those having a capacity of 1450 cc or more are found most often in the highly civilized races *Mesocephalic* skulls (1350 to 1450 cc capacity) and *microcephalic* skulls (a capacity of less than 1350 cc) are found in individuals of the lesser civilized and more primitive races

Landmarks Several anatomic structures are found to be of value as landmarks in describing the location of lesions which may be

Tests for Eighth Nerve Function Acuity of hearing (*cochlear portion*) may be tested by the spoken or whispered voice, the tick of a watch tuning forks or by more complicated types of apparatus such as the *audiometer* Furthermore a vibrating C 256 tuning fork may be held against the mastoid process The vibrations heard in this manner represent *bone conduction* Normally after the vibrations can no longer be heard by this technic the fork may then be held close to the ear and it is again heard by *air conduction* (Rinne s test) In the normal person if a vibrating tuning fork is held against the forehead and one ear is occluded by a finger the vibrations are heard best on the obstructed side (Weber s test)

Several maneuvers may be used in testing the *vestibular* portion of the eighth nerve The test for *past pointing* involves the subject s raising his outstretched arm above his head and then bringing it down in front of him the index finger to touch the examiner s finger It is done first with the eyes open and then with them closed The *Barany test* consists of irrigating one or the other external auditory canal with cold water which stimulates the semicircular canals In the normal subject this causes vertigo a nystagmus to the opposite side past pointing to the same side nausea and vomiting The *rotation test* consists of spinning a person in a rotating chair in a manner similar to that of children in winding up a swing and letting it spin The normal person after rotation tends to fall toward the side of rotation shows past pointing (the patient s finger pointing past the examiner s) to the same side and has nystagmus to the opposite side

FACE

The face is a composite of a number of anatomical structures several of which are subject to detailed examination and are of exceeding importance in the diagnosis of disease Important in this respect is the recognition that observations made regarding the functions of the several anatomic structures of the face actually represent a most important phase of the neurologic examination Detailed examination of the face and its structures provides an evaluation of the normal or distorted function of the *cranial nerves* This will become evident below and in Chapter 6

recognized in its differentiation from tumefactions due to disease to be mentioned in Chapter 6 In some persons the lobe of the ear may be small and fused with the skin of the face However, in most subjects the lobe is separated from the face by an indentation Furthermore there is much variation in normal persons in the size of the external auditory canal and the directness with which it extends to the ear

Fig 1 Darwinian tubercle

drum In some persons the drum may be seen without a speculum especially if the auricle is pulled outward from the head and slightly backward to assist in straightening the canal in most cases however, a speculum will be necessary Examination of the external auditory canal with or without a speculum will show a varying amount of cerumen or wax and a tympanum which is of such luster as to reflect light

In the otolaryngology clinic the student will be introduced to the use of the otoscope or of the ear speculum and head mirror, so that the tympanum may be inspected more satisfactorily as to color contour, integrity, and the like The mastoid region is examined as a part of the examination of the ear, involving both inspection and palpation

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Expression In addition, however, the face as a whole is of interest and deserves constant study while the physician is interviewing and examining the patient For him who will see, the face will portray emotions, pain, intelligence and understanding The dull witted person lacks the sparkle and expressive face of the intelligent understanding person In history taking the physician must recognize the

Fig 2 Fig 3 Fig 4

Fig 2 The round (oval) face with the rounded dental arch
Fig 3 The square face with the square dental arch
Fig 4 The triangular face with the triangular dental arch
(Courtesy C W Adams D D S Dentists Supply Company)

puzzled expression indicating a question not well understood Tiredness, apathy, and pain are so often plainly written on the face that they need only to be mentioned The emotions as expressed by the face are of especial importance to the physician The blushing of embarrassment the flushing or whiteness of anger and the fear and anxiety outlined in the face are helpful in the interpretation of answers to questions The face often gives the lie to the spoken word

Physical Characteristics From the purely physical viewpoint, the

face in the healthy person gives us certain information The racial characteristics of the Negro the American Indian the Oriental and the like need not be detailed

There is slight asymmetry of the face normally, the two halves of the face differing a little This is demonstrated well by the trick of producing two faces from a photographic negative cut in two using each half to make a complete print the two faces being quite unlike at times

Color The color of the face may be of importance in disease, as will be shown in Chapter 6 However the variations in color as seen in normal persons may be great In Chapter 3 on general considerations attention was given to the skin color of the blonde and the brunette person Continual exposure to the elements—sun wind and salt water eventually lead to a tanning of the skin and a leathery appearance It is seen in the farmer the outdoor laborer, and at its best in the cowboy of the arid Southwest or in the sailor of sailing vessel experience Though it is abnormal it must be recognized for what it is and not as disease

Some healthy persons have a plethoric (ruddy) and some a sallow (muddy) appearance Others equally healthy and with normal hemoglobin and red cell levels appear to be pale The lack of relationship of the blood levels to the color is notorious since the color is related to the degree of dilatation of the skin capillaries and not to the hemoglobin level alone

Face Types Of interest are the face types that help in classifying the person as to his general constitutional group This was considered in some detail in Chapter 3 Thus there are the round face the square face and the triangular face each having associated with it the round the square and the pointed dental arches (Figs 2 3 and 4)

Anatomic variations of the lower jaw are great such as the receding chins and protuberant chins These are often related to malformations or malocclusions of the teeth and yet occur so frequently in the population that one hesitates to designate the changes as constituting disease Rather they are developmental anomalies

As will appear in Chapter 6 the several structures making up the face must be examined in detail Therefore it is necessary to call attention to the normal variations and conditions of these structures

Forehead

The level of the hairline varies with constitution and heaviness of the hair growth (The hypersthenic person commonly has a heavier growth than the asthenic person) The variation is great from subject to subject In some the hairline is low on the forehead, in others it is receding or high The latter commonly occurs with increasing age *The skin of the forehead may be smooth or furrowed with* wrinkles, the latter due to habit or age The eyebrows also vary greatly, in some persons the hair is sparse in others there is a heavy growth In some the eyebrows may meet in the midline The ability to wrinkle both sides of the forehead by looking upward provides proof of an intact seventh cranial nerve

Eyes

Inspection of the eyes logically begins with the eyelids followed by observations of the position of the eyeballs as related to the orbit and of movements of the eyeballs Then, the observer is ready to inspect

Fig 5 Epicanthus as indicated by arrow

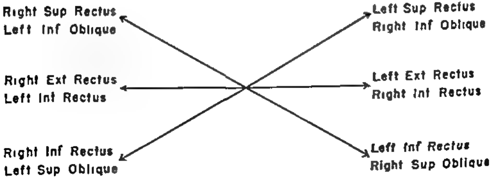

Fig 6 Diagram indicating cardinal directions of gaze and muscles involved

in more detail the individual structures such as the lacrimal drainage apparatus conjunctiva sclera cornea iris pupil and optic fundus

Normal to the Mongolian race and in some Caucasian children a fold of skin covers the inner canthus of the eye an *epicanthus* In white children it usually disappears with full development of the nose (Fig 5)

Eyelids and Eyeballs The eyelids normally show no swelling except occasionally after a period of deep sleep with absence of lid motion during which some free tissue fluid accumulates in the loose areolar tissue It rapidly disappears with movement of the eyelids after awakening Nice judgment is often necessary to determine

Fig 7 Pigmentation in sclera of normal white person

whether *prominent eyes* represent an abnormality or whether the prominence is normal for that subject Often one can rely only upon the history in this regard Some races notably the Negro may show such prominence frequently The *intra ocular fluid pressure* is estimated by palpation of the eyeball through the upper eyelid

Movements The movements of the two eyes should be equal as they follow the examiner s fingers into the different directions of gaze which engage the synchronizing extra ocular muscles These six directions as shown in the diagram (Fig 6) are known as the cardinal directions of gaze On extreme lateral gaze there may be a slow periodic limited to and fro movement of the eyeball the so called nystagmoid movement As the eyeball is moved upward or

downward the upper lid should move concurrently Normally, as the examiner slowly brings his finger or other object from a distance toward the subject s nose, the two eyes should converge as they focus on the approaching object The testing of the eye movements provides information concerning the function of the *third fourth, and sixth cranial nerves*

Sclera The sclera should be pure white except for a few small vessels visible in the bulbar conjunctiva In the full blooded Negro the sclera exposed in the lid slit may show quite a heavy deposit of brown pigment Occasionally, pigmentation is found in normal white persons (Fig 7)

Conjunctiva The bulbar conjunctiva is inspected in observations of the sclera To inspect the remainder of the conjunctival sac certain maneuvers must be carried out The conjunctiva of the lower lid is brought into view by the examiner placing his index finger on the lower lid drawing it down and asking the subject to look upward The conjunctiva of the upper lid is inspected upon everting the lid as follows The examiner grasps the eyelashes between the index finger and thumb of one hand, placing the tip of the other index finger rather high and firmly on the upper lid The patient is then asked to look downward and as he does so the examiner pulls forward and upward on the eyelashes Thus the tarsal plate is everted the finger on the lid acting as the fulcrum The palpebral conjunctiva is normally pink in color with visible blood vessels

Lacrimal Apparatus The lacrimal apparatus in the normal person reveals nothing of consequence upon examination The lacrimal gland usually cannot be felt The puncta may be recognized at the inner canthus one each upon the upper and lower lid

Cornea The cornea should be transparent The *corneal reflex* may be tested for if desired By drawing a fine wisp of cotton across the surface of the cornea this winking reflex may be elicited as a normal phenomenon owing to the contraction of the orbicularis oculi

Iris As is well known the iris is of variable color brown gray or blue Occasionally, a person may be seen with one brown iris the other being blue or gray, interesting from a genetic point of view

Pupils The pupils should be round and of equal diameter if both are exposed to the same intensity of light the brighter the light the

more constricted the pupil Normally they are 3 to 4 mm in diameter The pupillary constriction due to light is the so called *light reflex* This reflex is most readily tested by having the subject look at a distant point Then with the aid of a flashlight the eye is suddenly exposed to a bright light This results in a prompt constriction of the pupil Normally flashing a light into one eye causes prompt contraction of the pupil of its fellow as well this is the *consensual reaction* Occasionally in normal persons the pupil alternately contracts and dilates during exposure to light This is known as *hippus*

With distant vision the pupil dilates moderately When vision is quickly changed from distant vision to a point 6 or 8 inches from the eyes the pupil constricts—the *accommodation reflex* (It is held by some that this is actually a convergence phenomenon rather than that of accommodation) The technic for demonstrating this is obvious The subject looks at a distant object and then quickly looks at the examiner s finger or some other object held a few inches from the eye

Lens Normally inspection of the lens is nonrevealing in fact it can be examined satisfactory only with an ophthalmoscope

Ophthalmoscope The student should be thoroughly familiar with the use of the ophthalmoscope for the study of the interior of the eyeball This instrument provides a source of light and a series of convex and concave lenses with which various depths of the global structure from its corneal surface to the eyeground, may be brought into focus The cornea aqueous humor lens and vitreous humor constitute the transparent structures which refract light The retina choroid and optic nerve compose the visible portions of the eyeground where light images are received to be transmitted to the brain In the eyeground nervous and vascular structures are laid out for study as nowhere else in the living body (Plate 1)

The variations of the normal *fundus* should be well known because numerous diseases cause alterations of diagnostic or prognostic significance Normally the reflex from the optic fundus is of a reddish hue The thickly meshed *blood vessels* in the choroid and the dark pigment which overlies them are responsible for the color In the retina the smaller, red arterioles are easily distinguished from the purplish larger veins The arteriole is smaller than the vein in a ratio of approximately 2 3 The *optic nerve head* from which the

vessels emerge is readily recognized and must be carefully studied Even though the ophthalmoscope is used daily by the internist, neurologist, and neurosurgeon, the author will forego further discussion at this point The use of this instrument is learned best in the eye clinic Textbooks on ophthalmology should be consulted for further details

Sight Sight may be tested for in a rough manner by covering one eye and testing the other for vision, after which the process is reversed The patient is asked to read letters progressively smaller in

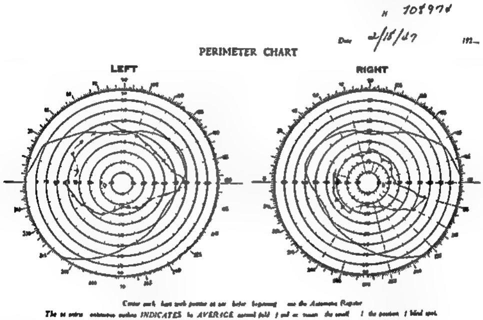

Fig 8 Visual fields as determined by aid of perimeter (Normal fields are indicated by symmetrical large areas of even contour Constriction of field of vision due to tumor of pituitary gland is shown by smaller asymmetrical and irregular pattern toward center in each chart)

size upon a test chart (The oculist attempts to improve vision by performing refraction, which is the fitting of lenses) When vision is considerably impaired it may be tested by finger counting The examiner extends one or more of his fingers in the patient s line of vision asking him to state the number of fingers which he sees Further diminution may reduce sight so that the patient can only discover movement of the examiner s hand or other object before the eye

For accurately testing the *field of vision* such instruments as the perimeter or tangent screen should be used These provide for the

measurement of the expanse of the field of vision by charting the points in the periphery of the field at which small test objects are recognized While the patient directs his eye toward the center of the field the small objects are made to enter along the various meridians of its periphery (Fig 8) The visual field can be crudely examined by the *confrontation test* With the palm of one hand covering his left eye the patient is directed to look at the examiner s left eye as he faces him at a distance of an arm s length The examiner closes his right eye extends his arms full length to right and left and gradually brings the moving fingers on one side and then the other inward until the patient recognizes the movement The procedure is repeated with the arms extended along all the meridians of the field and the subject indicates the point in each meridian at which the movement of the fingers becomes apparent In this way the examiner may compare the subject s field of *vision with his own*

Nose

For the purposes of the general physical examination as *outlined* in this book the examination of the nose will be limited to simple inspection and palpation Thus the nose is inspected in general as regards its shape contour and the skin covering *it*

There is little to be said about the normal nose Nothing is to be gained by a description of its *contour* The reader is well aware of the great variations which occur as among individuals and as between races

Inspection of the *nasal passages* involves merely the flashing of a light into one nostril and observing the mucosa and other structures on that side and then on the opposite side by the light transmitted through the septum The *septum* may be best inspected by this mode of transillumination The nasal septum should be straight though some deviation is common even in the absence of disease and trauma The light will reveal the pink color of the normal lining of the nostrils A variable number of hairs will be found within the nares fewer in women than in men and more in the hairy males With increasing age these become greater in number and length

The simple inspection of the nostril with a flashlight may be extended by the use of a nasal speculum and headmirror thereby

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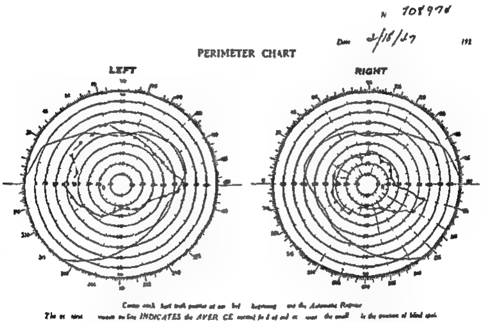

Fig [illegible] Visual fields as determined by aid of perimeter (Normal fields are indicated by symmetrical large areas of even contour Constriction of field of vision due to tumor of pituitary gland is shown by smaller asymmetrical and irregular pattern toward center in each chart)

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mally, these labial movements will result in symmetrical positions of the lips and angles of the mouth

Mouth

Examination of the mouth should be carried out in some routine fashion so that no portion may be missed Inspection of the teeth may well be the first step in the examination From there the examination would proceed logically to the gums Next one may examine the tongue then the buccal cavity in general including the buccal mucous membrane the mucosa of the inner aspects of the lips the floor of the mouth and the areas of the hard and soft palates

GUMS AND TEETH

Normal dentition implies the eruption of the *deciduous teeth* at from six months to about three years of age These are replaced by the *permanent teeth* the first appearing at about six years of age the second molars appearing at from twelve to fifteen years Finally the third molars or wisdom teeth appear at from seventeen to twenty five years of age The variations in size and the spacing and irregularity of teeth in normal persons are many Note should be made of the number of teeth in the various categories (such as incisors or molars) which are present

The healthy *gums* are pink in color and their edge is closely applied to the teeth at the level of the junction of the crown with the neck A noteworthy racial variation in the color of the gums is met with in the full blooded Negro Here the gums may be of a bluish color occurring either diffusely or in splotches In others of the Negro race brown pigment is present in the gingival mucosa

TONGUE

In examination of the tongue by inspection one notes first its gross appearance attention being given especially to the papillae Its *size* and *movements* should be studied also (Several constitutional diseases have important signposts on the tongue) The subject should be requested to elevate the tongue so that the underside may be inspected also Movements of the tongue are a test of the function of the *hypoglossal nerve*

making visible the nasal passages to a higher level By the use of a light containing nasopharyngoscope, the rhinologist can inspect the highest portions of the nasal passages and nasopharynx Transillumination of the *paranasal sinuses* is carried out in a dark room By having a patient hold an electric light in his mouth the paranasal sinuses may be inspected as to their ability to transmit light, dependent upon the normal freedom from, or the abnormal presence of, contained secretion or hypertrophied mucosal lining

Though palpation may be employed in examining the septum externally, its main use lies in the determination of the absence or presence of tenderness over the paranasal sinuses (Tenderness may be expected in acute sinusitis) Firm pressure upward on the roof of the orbit from beneath the orbital ridge, and over the area of the frontal sinus itself, may be used to demonstrate tenderness Similar pressure lateral to the nose just below the malar prominence may be used to elicit tenderness due to disease of the antrum

Intactness of the olfactory nerve can be demonstrated by testing the *sense of smell* This is done simply by having the subject close one nostril and then smell substances commonly recognized such as tobacco coffee oil of peppermint, and the like

Lips

In approaching the examination of the mouth the lips obviously are the first structures to attract attention Normally they are smooth and pink in color Exposure, as from drying in the wind causes scaling or desquamation Prolonged exposure to wind and sun as in the case of the farmer cowboy or sailor leads to permanent changes in the lips which may be mentioned here for they are not the result of disease Under these circumstances the mucous membrane becomes thickened and is of a bluish or purplish color Due to the submucosal scarring by ultraviolet rays and the chronic inflammation of drying the capillary loops become prominent and are seen as red dots over the lips The inner aspect of the labial mucosa can be seen best by having the subject use the fingers of both hands to evert the lips

The integrity of the *seventh cranial nerve* may be tested by instructing the patient to purse his lips, whistle or to show his teeth Nor

so-called scrotal tongue suggesting the wrinkled scrotum* (Fig 9) It apparently has no significance in terms of disease

After the fifth decade an increasing number of persons with advancing age will show varicosities in the sublingual venous system Spherical ones are known as *caviar lesions* and vary in size from one to several millimeters in diameter (Fig 10)

Fig 10 Caviar lesions of tongue

BUCCAL CAVITY

Having inspected the lips gums teeth and tongue the walls of the buccal cavity should be examined next This includes the buccal side of the cheeks the hard palate the soft palate and the tonsils

Mucous Membrane The mucous membrane usually is pink in *color* in the white person (In the full blooded Negro the mucosa is of a bluish color which in the white person would suggest cyanosis At times the blue color has an uneven or splotchy distribution Again in the Negro brown pigmentation may be present in the buccal mucosa) The papilla marking the opening of *Stensen s duct* will be recognized opposite the upper molars (Many persons spot this papilla with alarm believing it to be a tumor) The mucosa of the floor of the mouth contains numerous venules

Hard Palate The hard palate is broad or narrow depending upon the dental arch as related to the constitution of the person Thus the square faced person of the sthenic or hypersthenic build has a dental arch more square in front and a hard palate which is broad and quite

* Some students of nutrition have attempted without good evidence to associate such changes of the tongue with deficiency states

In the normal person the *color* should be pink Brown pigmented dots singly or in groups, especially at the borders of the tongue are not uncommon in Negroes The *prominence of the papillae* varies from person to person The so called "coat on the tongue is seen commonly and consists merely of desquamated epithelium, food particles and so on entangled in the filiform papillae at the central

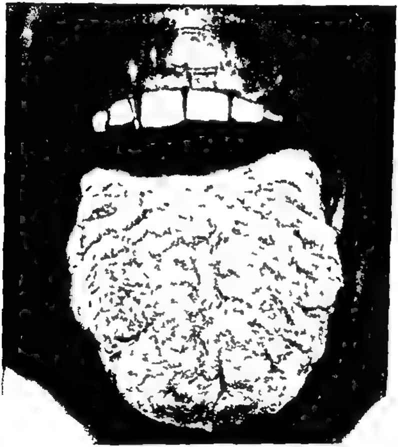

Fig 9 Scrotal tongue

and posterior portions of the tongue (The student must not forget that the hypochondriac patient who inspects his tongue in the mirror lays great emphasis on the coat of the tongue and may interpret the circumvallate papillae as evidence of disease) In some normal persons, the tongue may present several deep crevices the *furrowed tongue* In others, irregular furrows and elevations account for the

view as well as the base of the tongue In most normal persons the touching of the posterior wall with the tongue depressor will cause gagging—the *gag* or *pharyngeal reflex* It is a function of the ninth and tenth cranial nerves

LARYNX

The larynx may be viewed by the use of a mirror similar to the one used by the dentist and a head mirror To carry out this maneu

Fig 11 Technic for inspection of the larynx by use of the laryngeal mirror

ver the observer grasps the tongue with the aid of a towel or gauze and pulls it out with one hand he holds the mirror in the proper position with the other and observes the larynx with the aid of a head mirror which acts as the source of light (Fig 11) Movement of the vocal cords may be elicited by having the subject phonate This technic will be learned in the otolaryngology clinic

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flat The asthenic person with the narrow face will have a more pointed dental arch and a highly arched narrow palate (Figs 2 3, 4) There are all degrees of variation between these two extremes The mucosa covering the hard palate is often lighter in color and of a somewhat yellowish tint because it has little submucous tissue being applied quite closely to the periosteum

Soft Palate The soft palate should be observed upon phonation to note the normal movements as by having the patient say 'ah The *ninth and tenth cranial nerves* supply the motor nerve fibers to the soft palate The length of the *uvula* should be noted The *palatal reflex* is manifested by bilateral elevation of the palate when it is touched

Tonsils The tonsils vary greatly in size, especially in the several age groups In youth the tonsils are large projecting well toward midline from the tonsillar fossae In the latter part of the third and in the fourth decade, they begin to atrophy gradually becoming less prominent so that in the aged the lymphoid tissue usually has re gressed to such a degree that the inexperienced examiner may suspect that a tonsillectomy had been done

PHARYNX

In most persons the tonsillar area and the oropharynx cannot be inspected by having the patient merely open his mouth A tongue depressor is usually necessary to provide adequate exposure of these parts The tongue muscles are very strong and the subject may easily prevent the examiner from depressing the tongue if the depressor is not applied properly The trick in applying the depressor is to place the tip back of the junction of the horizontal and vertical portions of the tongue thus using this point as the fulcrum Then forward and downward pressure can be maintained against almost any resist ance that even a crying child can exert

Though the *oropharynx* is inspected usually by the use of the tongue depressor some subjects can display the pharynx without this aid Upon inspection of the posterior wall of the oropharynx one may note especially in the young the small elevations representing lymph follicles In some persons, either with the use of a tongue depressor or by having the patient grasp his tongue with the help of a handker chief or gauze and pull it forward the *epiglottis* may be brought into

of the skull in which no bone can be felt and the examiner has the impression of palpating a bag of water (Fig 1) Ossification is com pleted in mild forms (Fig 2) In adult life enlargement of the skull is encountered in *osteitis deformans* (Paget s disease) (The patient becomes aware of this in his need for a larger hat) In this disease

Fig 2 Hydrocephalu of mild degree with complete ossification of skull

there is great thickening of the bones with bowing of the long bones probably because of some as yet unknown local metabolic change in bone With marked thickening of the cranium the face may appear disproportionately small (Fig 3) *Leontiasis ossea* may be a related disease with prominent involvement of the facial bones The head may appear large in *acromegaly* owing mainly to changes in the facial bones to be described on page 168

6. THE HEAD—2

FINDINGS IN DISEASE

SKULL

Contour and Size The contours of the skull are altered in a number of developmental conditions and in a few diseases

Macrocephalus is descriptive of the abnormally large head It may occur either in congenital or in acquired *hydrocephalus*, where dilatation of the ventricles of the brain occurs, owing to a block in the communicating system The acquired type must develop before the sutures have closed In extreme cases there are usually large areas

Fig 1 Hydrocephalus of severe grade preventing ossification of skull

A *square head* appears abnormally large as well though actually it is not The contour is usually due to prominent *bosses* of the frontal bones This may occur in the healing of the bone lesion either of rickets or of congenital syphilis (If caused by the latter the frontal

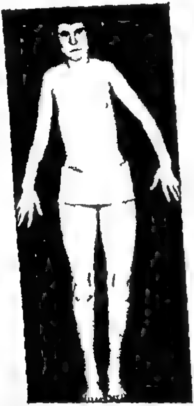

Fig 4 Microcephalus and feeblemindedness (age nineteen) Legs show lacy pigmentation resulting from erythema ab igne

bosses are known as Parrot's nodes) A rare congenital anomaly and one incompatible with life is that of *encephalocele* in which a portion of the brain with its meninges is herniated through a defect in the skull (Fig 5)

Fontanels The fontanels may *remain* open beyond the usual time because of rickets congenital *syphilis* or cretinism Bulging of the fontanels found upon inspection or palpation often accompanies

Microcephalus or abnormal smallness of the head, may result from lack of development of the brain, or loss of brain substance because of hemorrhage at birth (Fig 4) It is accompanied commonly by idiocy

Fig 3 Paget s disease

Oxycephalus (tower skull) is probably due to abnormal centers of ossification and early closure of the cranial sutures, causing the vertex and superior surface of the skull to be somewhat pointed It may be accompanied by blindness and deafness because of cranial nerve involvement by overgrowth of bone in the base of the skull The cause *of this deformity is often obscure However, it is known* to occur at times in congenital hemolytic icterus and in sickle cell anemia

tapping over the skull may help to localize tenderness at the sites of inflammation or tumor of bone Auscultation is valueless except in the rare instances of arteriovenous fistula between the cavernous sinus and the internal carotid artery or even more rarely in intracranial aneurysm A murmur may be heard under such circumstances if the stethoscope bell is applied to the skull

Scalp and Hair

The scalp is affected by many of the diseases which involve the skin as a whole Thus macular papular pustular and desquamating skin lesions may be found on the scalp *Tumors* of the scalp may be lipomas sebaceous cysts (wens), gummas malignant or leukemic nodules and the like (Figs 6 7) In *acromegaly* the scalp is thick as manifested by folds because of the general splanchnomegaly (Fig 8) The hair may harbor *parasites* (lice) Their ova are attached to hairs and these sacs no larger than a pinhead are known as nits The *texture* of the hair may change in disease In *myxedema* the hair becomes dry sparse coarse and brittle. These changes result from decreased blood supply and the characteristic subcutaneous tissue reaction of myxedema Similar changes in the hair may occur as the result of poor *nutrition* of the hair papillae in cachexia or in starvation

Alopecia or abnormal hair loss occurs in a variety of conditions It may be generalized in prolonged acute infectious disease, as in typhoid fever being related to vascular and nutritive disturbances in the hair papillae. Alopecia may occur in the rare cases of *thallium intoxication* In either instance growth of hair again takes place *Alopecia totalis* is probably caused by an endocrine disturbance and may be congenital or appear later in life (Figs 78 79 pages 123 124) Diffuse *patchy alopecia* occurs in secondary syphilis presenting a moth eaten appearance (Fig 9) *It is* caused by a follicular invasion by the *Treponema pallidum* *Alopecia areata* is quite common and usually of unknown cause One or several areas of complete baldness varying in size from a five-cent piece to that of a silver dollar may be found It may be due to localized skin disease (Fig 10) but more often is probably caused by impairment of the trophic nerve supply

any condition associated with increased intracranial tension before closure

Asymmetry Asymmetry of the skull may be due to a variety of causes: Developmental *abnormalities may occur* *Indentations* may be seen or felt as the result of depressed skull fractures Localized elevations may represent bone tumors—primary, metastatic, or leukemic—or inflammation, as in osteomyelitis, syphilitic osteitis (gumma), or periostitis

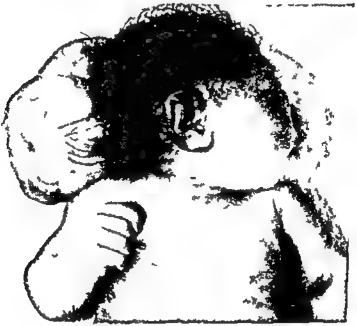

Fig 5 Encephalocele

Movements of Head *The head may be fixed in one position* owing to disease of the cervical spine or spasm of the neck muscles (torticollis) (Figs 1 2 page 248) *Retraction* of the head may be seen in meningitis as a reflex attempt to relieve tension on the acutely inflamed meninges (Fig 31 page 83) Certain jerking movements of the head may be caused by *habit tic* or *chorea* *Nodding* of the head with systole may occur in free aortic regurgitation because of the absence of *sustained intra aortic and therefore,* peripheral vascular diastolic pressure

Palpation, Percussion, and Auscultation of Skull Pressure or

Fig 9 Moth eaten alopecia of secondary syphilis

Fig 10 Alopecia areata due to local disease of skin

Ears

Various congenital malformations may be seen at times (Figs 11 12) Inspection of the auricle may be helpful not only in the diagnosis of local disease but at times in more distant and constitutional disease

Color The bluish color of *cyanosis* as encountered in the anoxemia of certain diseases of the heart and lungs may be obvious upon inspection of the lobe of the ear A similar impression is given in the presence of the increased hemoglobin of polycythemia and in the methemoglobinemia of acetanilid poisoning The duskiness can be well shown by pinching the lobe to press out some of the color and observing its slow return *Pallor* or excessive *redness* may indicate underlying vasomotor disease The frostbitten ear is cadaveric white in color because of the closed capillaries Redness of the auricle is part of the general flushing in fever and of any other disease associated with capillary dilatation in the skin

Fig 6 Sebaceous cyst of scalp

Fig 7 Hematoma of scalp as result of trauma Note laceration above right eyebrow

Fig 8 Thick vertical folds of scalp tissue in acromegaly

Tumefactions Tumefactions of the auricle result from several causes The *tophi* of gout diagnostic of this disease, consist of one or more nodules in the helix of the ear On palpation they give the impression of being concretions which they truly are, consisting of sodium biurate crystals as shown by microscopic examination of material extracted after needle puncture *Sebaceous cysts* are soft subcutaneous tumors found especially in the lobe of the ear

Edema Visible or palpable edema may be encountered back of the ear either in disease of the mastoid bone or in inflammation of the external auditory canal

External Auditory Canal Upon inspection of the *external auditory meatus* blood may be found following a basal *skull fracture* Drainage of the clear spinal fluid may indicate the same lesion Serosanguineous or frankly purulent fluid may be found in *middle ear infections* with perforation of the drum

By use of the speculum and suitable lighting *impacted cerumen* foreign bodies or insects may be seen in the canal Furunculosis or diffuse inflammation due to pyogenic or fungus disease may be found to involve the walls of the external auditory canal The red bulging *eardrum* of acute middle ear disease is pathognomonic Perforation of the drum with drainage of pus may have occurred In chronic otitis media the drum is lusterless and usually presents a perforation

Eighth Nerve Deafness resulting from middle-ear disease (conduction deafness) is accompanied by normal bone conduction since the nerve is intact However air conduction is decreased or absent because the middle ear apparatus is affected

Disease of the *cochlear division* of the eighth nerve will be manifested by loss in the acuity of hearing to a varying degree Such (perceptive) deafness is manifested further by a loss of air conduction and by the ability to lateralize tuning fork vibration (Weber test) to the unaffected side Such changes are usually due to affections of the peripheral portion of the eighth nerve as in acute infection caused by typhoid fever leukemic infiltrations syphilis multiple sclerosis disease of the adjacent bone tumors pressing upon the nerve and the like

Displacement Displacement of the auricle to a minor degree may be an anatomic variation It may be displaced outward by swelling of the parotid gland Of greater importance is the forward and outward displacement as the result of swelling of the soft tissues overlying inflammatory disease in the mastoid bone Outward and upward

Fig 11 Congenital anomaly of auricle

Fig 12 Absence of external ear

displacement occurs in furunculosis of the auditory canal with swelling of the tissues surrounding the external auditory canal

Deformity The *cauliflower ear* seen most often in pugilists is a deformity due to loss of the normal cartilaginous support Because of injury and bleeding into the tissues loss of continuity of the cartilage occurs

during pregnancy and often permanent to some degree is sometimes encountered distributed over forehead cheeks and neck—the so called mask of pregnancy (Fig 14 page 56)

The slate blue color of *argyria* is likely to be more marked over the face because the deposit of silver is more intense upon exposure to sunlight

Fig 13 Hemangioma

Skin Disease The facial skin may partake of the general skin disease of a great number of conditions It is a common site of hemangioma of congenital origin (Fig 13) In some dermatologic conditions the skin of the face may be characteristically free and in others it may be especially prone to involvement Examples of the latter are erysipelas lupus erythematosus and at times septicemia

In the detection of disease of the *vestibular portion* of the eighth nerve, the Barany, rotation and past pointing tests are helpful in that the results are not those expected in the normal These abnormal responses occur in cerebellar disease also when these pathways are involved

FACE

Color The color of the facial skin may reveal little more than might be seen in the skin elsewhere on the body However, abnormalities in color may be noted first in the face because this skin area presents itself for observation as the history is being taken The pallor of anemia may be unmistakable The yellow color of moderate *jaundice* or the olive green of marked long standing jaundice with deposit of much bile pigment in the skin may be seen The lemon yellow tint of pernicious anemia may be suggestive of the diagnosis Again the yellowish pallor or *sallow* color, of chronic illness may be noted a color at least partially due to anemia

The patient suffering from hypertension may present the *red* suffusion described as "plethoric" By contrast the patient with polycythemia and attendant high hemoglobin level has a more *bluish red* color On the other hand the patient suffering from oxygen lack presents *cyanosis* a bluish color, or duskiness, which may be especially marked over the cheek bones and in the skin of the ears This is exemplified well in some patients with mitral stenosis In the rare instance of obstruction to the venous return from the head and neck, as in disease within the upper mediastinum, the skin of the head, face and neck is diffusely cyanotic The so called malar flush is said to be characteristic of tuberculosis It represents merely a flush due to fever in one having a thin pallid skin

Pigmentation of the skin of the face is commonly caused by exposure to sun and wind In endocrine disturbances scattered or diffuse pigmentation may be encountered This is especially true in adrenal and thyroid gland disease as was mentioned in Chapter 4 The pigmentation may be noted better in the face in *Addison s disease* where the skin may appear tanned or of a dirty hue Black freckles on the face or neck may accompany this pigmentation (Fig 38 page 92) (A related physiologic, brown pigmentation, occurring

the face is similar but owing to the wasting of subcutaneous tissues the skin is often drawn tightly over the bony prominences A waxy yellow color may be present and the skin may be parchment like (Figs 24 25 pages 78 79) Often there is the appearance of constant pain The *facies* of *chronic illness* so often is a combination of these two facies

Fig 15 Beard of recent growth in thirty five year-old woman

The facies in later stages of *hepatic cirrhosis* is often of the cachectic type with a slight brownish and at times icteric, tint dilated venules and spider angiomas

In contrast to the dehydrated and cachectic facies we have that of *edema* (Fig 16) This is seen at its best in renal disease and is due to water retention The face is puffy and pale The edema is

These skin diseases may assume a characteristic pattern over the bridge of the nose and cheeks in a so called 'butterfly' distribution on the basis of the vascular supply (Fig 14)

The Beard The beard may be sparse or disappear entirely in certain endocrine diseases, with the loss of secondary sex characteristics in the male On the other hand, as part of *virilism* a beard may occur in women (Fig 15)

Fig 14 Butterfly lesion of lupus erythematosis

Facies This term means the appearance of the face as a whole As such a great variety of facies are recognized as being either suggestive of or characteristic of certain conditions or diseases Though the major feature, lending the paramount characteristic in the facies may involve only one facial structure it is the composite of all facial components which establishes the facies

Dehydration from any cause is characterized by a dry, wrinkled skin sunken cheeks, pinched nose and hollow eyes In *cachexia*

syndrome) at times associated with drooling of saliva (Fig 17) in general paresis the face may have a vapid expression in schizophrenia a silly expression may be present the patient having tabes dorsalis may present a smoothed out facies and the wild excited face of mania represents fear and fury

Fig 17 Expressionless facies of postencephalitic parkinsonism

In addition to the somewhat generalized types of facies there are very specific ones practically diagnostic in many instances

The *adenoid* facies seen especially in children is characterized by the thin face pinched nose high arched palate often a receding chin mouth breathing and frequently a stupid expression The abnormalities result from breathing through the mouth because of nasal obstruction

especially emphasized in those areas where the subcutaneous tissue is of the loose areolar type, as in the eyelids Edema also occurs in heart disease, angioneurotic disease, erysipelas trichiniasis and in the rare cases of obstruction to the venous return from the head. Edema may be asymmetrical if the patient has so lain that one portion of

Fig 16 Edema of nephrosis Generalized puffiness of face eyes cannot be opened because of palpebral swelling

the face has been dependent Thus the patient with the dropsy of heart failure having slept for some hours on his side may present a grotesque appearance the uppermost side is not unusual, the lower most side is puffy, the eye is swollen shut and the lips also are swollen on the one side

In *neuropsychiatric disorders* the facies may be diagnostic There is the expressionless, masklike face of paralysis agitans (Parkinson s

Fig 19 Mongolian idiocy

Fig 20 Leonine facies of nodular leprosy (Courtesy of Dr Clarence Shaw)

Acromegaly provides an appearance of a face molded on massive lines The features are coarsened by the massive supraorbital ridges the prominent malar eminences the large, protruding lower jaw and the accompanying large nose and thick tongue and lips The reasons for these changes were noted in Chapter 4 (see Fig 12 page 70)

Fig 18 Facies of exophthalmic goiter Note fulness of neck

The *exophthalmic-goiter* facies is described as that of a startled or frightened person This is owing essentially to the wide eyeslits the protruded eyeballs and the quick movements of the eyes (Fig 18)

In *myxedema* by contrast the facies suggests apathy or stupor Though the face appears swollen it does not pit as from edema, the skin is dry coarse and of a sallow color The nose is broad the lips and tongue are often thick (Fig 16 page 73) The eyebrows and lashes may be sparse or absent altogether In the male, the beard

mation may involve both parotid glands with symmetrical deformity (Fig 21)

Asymmetry of Face Though a slight difference between the two halves of the face is usual noticeable asymmetry is found in the rare cases of *hemiatrophy* in which one half of the face is noticeably smaller Such a change is thought to be caused at times by a vasomotor

Fig 22 Facial hemiatrophy

disturbance and again by disease in the cervical sympathetic tract (Fig 22)

The most commonly encountered asymmetrical face is seen in *paralysis of the facial nerve* (in Bell s palsy and in hemiplegia) (Fig 23) The former is practically always a unilateral disease The paralysis of the seventh nerve may be peripheral (infranuclear) or central (supranuclear) On the affected side the face is smoothed out and expressionless because of the loss of muscle tone The angle of the mouth on the affected side droops and the mouth seems

may be absent or sparse These signs result from the myxomatous infiltration of the subcutaneous tissue

Mongolian idiocy is clearly shown by slanting narrowed lid slits and a broad flat nose (Fig 19)

Fig 21 Face in epidemic parotitis

Leprosy is characterized by the nodular infiltrations of the sub cutaneous tissues giving rise to the descriptive term of 'leonine (Fig 20)

In *congenital syphilis*, the abnormalities of several of the facial structures combine to suggest the diagnosis by the facies alone (These will be noted on page 201)

Mumps (epidemic parotitis) is characterized by swelling below and in front of the ear often displacing the lobule outward The inflam

Unilateral sweating may be present owing to disturbances in the cervical sympathetic structures (Fig 24)

Facial asymmetry may be the result of localized *swelling* or edema of structures on one side of the face from inflammation or tumors (Figs 25–28) The unilateral swelling of the parotid gland in mumps is a good example In cavernous sinus thrombosis the affected side is swollen the eyelid being closed by edema

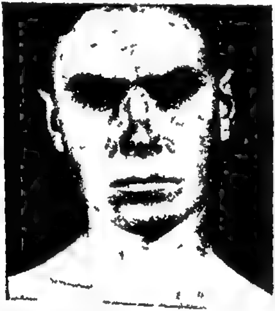

Fig 24 Left sided hidrosis due to involvement of cervical sympathetic nerves Beads of sweat may be seen on forehead cheek upper lip and chin

Movements of Face The most frequent abnormal movements seen in the face are those due to *habit tic* The patient having a tic may have periodic twitching of eyelids nose lips and the like In *chorea* the major changes are attributed to dysfunction of the basal ganglia Muscle movements may be extreme leading to grimaces and other distortions If tetany is suspected *Chvostek s sign* may be demonstrable the tapping of the trunk of the seventh nerve anterior to the external auditory meatus produces a drawing of the mouth toward that side A decrease in the ionized fraction of serum calcium accounts

for this increase in irritability of nerves Spasm of the facial muscles produces a grinning expression known as the "risus sardonicus," which is seen at its best in the extreme irritability of nerves affected by the exotoxin of *Clostridium tetani* (Fig 29)

Fig 25 Mixed tumor of parotid gland

Fig 26 Sarcoma of maxilla

In addition to these general considerations of the face and its structures, detailed examination of the individual structure is necessary because of the abnormalities which may occur in it

FOREHEAD

Prominent *bosses* of the frontal bone were mentioned earlier in the chapter (on page 155 in a discussion of the contour of the skull

Fig 27 Abscess of soft tissues

Fig 28 Hygroma cysticum

Fig 29 Risus sardonicus of tetanus

Fig 30 Tumors of forehead Lipoma on right On left mucocele arising from left frontal sinus (note edema of left eyelid) Anisocoria is also present right pupil being dilated left constricted

Fig 31 Gumma of forehead

Fig 32 Swelling of right eyelid due to arteriovenous fistula

Inspection may reveal depressed *scars* from syphilitic osteitis of past years Over a frontal sinus, a depressed scar may mark a former operation on the sinus *Lipomas not uncommonly appear as subcu* taneous tumors on the forehead (Fig 30) Disease of the frontal bone tumor or inflammation may be the cause of *asymmetry* of the forehead

Fig 33 Orbital abscess with edema of lids

Fig 34 Tumor of orbit

(Fig 31) Swelling and tenderness upon pressure often are demon strable over a frontal sinus in acute infection in this cavity The eye brows may be sparse or thinned (so characteristic of myxedema) or there may be an irregular thinning suggestive of secondary syphilis These thin eyebrows must be distinguished from those which have been plucked, a practice common among women

Eyes

Eyelids The eyelids are prone to show edema in a number of conditions Because of their loose areolar tissue intercellular fluid accumulation may become moderately prominent Edema is found

Fig 35 Swollen lids as result of spider bite

Fig 36 Enlargement of lacrimal gland (von Mikulicz's disease)

especially in acute nephritis nephrosis (see Fig 16) and trichiniasis Increased capillary permeability from the anoxemia of anemia may permit some degree of edema Inflammation adjacent to or in the eyelids may cause edema also as in acute sinusitis and infections of

Fig 37 Conjunctivitis and blepharitis Edge of lower lids has been rolled inward (entropion)

Fig 38 Ectropion of upper lid as result of scar extending upward over forehead

Fig 39 Hemangioma of eyelid

Fig. 40 Xanthomatous plaques

the lids themselves (Fig 30) Unilateral swelling of an eyelid and tissues of the orbit and even of the nasal bridge occurs in cavernous sinus thrombosis and in arteriovenous fistula (Fig 32) Tumor or inflammation in the orbital tissues also leads to unilateral swelling (Fig 33 34) Sensitivity to allergens drugs and insect bites as well as angioneurotic edema may account for noninflammatory swelling due to changes in capillary permeability (Fig 35)

Fig. 41 Chalazion

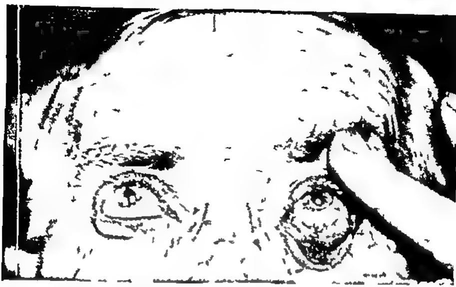

Fig 37 Conjunctivitis and blepharitis Edge of lower lids has been rolled inward (entropion)

Fig 38 Ectropion of upper lid as result of scar extending upward over forehead

Fig 39 Hemangioma of eyelid

As in the case of the eyebrows eyelashes may be lost partially or completely in myxedema and in secondary syphilis

Inflammation of the eyelids may be diffuse or localized In *blepharitis* the borders of the lids are red, swollen and often covered with dry crusts (see Fig 37) *Ectropion* is an eversion of the lid margin which may result from hypertrophy of the conjunctiva in inflammation It also may occur from the contracture of scars on the surface of the eyelid Some of the palpebral conjunctiva thereby becomes visible (Fig 38) It may also develop in the aged as part

Fig 44 Ptosis of left lid as result of paralysis of oculomotor nerve

of the generalized lack of tissue tone which permits drooping of the lower lid *Entropion* is the opposite condition in which the lid margin turns inward It is recognized as *cicatricial* when caused by contracture of conjunctival scars and as *spastic* when, in the presence of ocular inflammation sustained spasm of the orbicularis muscle of the eyelid occurs (see Fig 37) Localized infection usually takes the form of an infection in a hair follicle the *hordeolum* or sty identical to a pimple on the skin

Tumors may appear in the eyelids Benign ones such as fibromas are not uncommon though others are encountered also (Fig 39) A malignant tumor of the skin *epithelioma* may occur especially in the elderly These are of the type shown in Figs 53 56 (pages 103, 106) Oval yellow plaques known as xanthomas (lipoid deposits), may be found especially at the inner canthus of upper or lower lids associated at times with familial tendencies to hypercholesterolemia (Fig 40) Frequently the palpebral skin is darker than the rest of the facial skin in such cases A hard nodule in the upper lid may be a *chalazion*

Inflammation or tumor of the lacrimal glands may be the cause of swelling of the eyelids especially localized to the lateral portion of the upper lid (Fig 36) Mikulicz's disease is one with swelling due to a lymphocytic infiltration of the lacrimal glands with or without

Fig 42 Cyst of palpebral margin

Fig 43 Photophobia

similar involvement of the salivary glands The cause of this disease is unknown though often this clinical picture accompanies sarcoidosis and leukemia, in the latter the involved structures are infiltrated by the abnormal cells

Eyeballs *Exophthalmos* or protrusion results in a staring expression or one suggestive of fright (see Fig 18) This is a characteristic finding in a form of thyrotoxicosis (Graves disease), resulting from hypertrophy and hyperplasia of the thyroid glandular tissue Associated with the exophthalmos may be certain abnormalities in the position of the eyelids or in their movements (These findings have become known by the names of those describing them a confusing practice) The widened lid slit is characteristic (Dalrymple s sign) This widening is due mainly to retraction of the upper lid with exposure of a strip of sclera above the cornea (Stellwag s sign), a part

Fig 46 Unilateral exophthalmos due to hemangioma of orbit

of this picture also is infrequent winking of the eyelids In thyroid disease lid lag (von Graefe s sign) may be demonstrable As the eye is made to rotate alternately upward and downward it may be noted that the upper lid does not follow synchronously with the eyeball This is especially noticeable as the eyeball moves downward In attempts to make the eyes converge as by moving an object from some distance toward the nose convergence may not take place if there is exophthalmos (Mobius sign) * In exophthalmic goiter there also may be an absence of elevation of the eyebrows and wrinkling of the forehead on suddenly looking upward (Joffroy s sign) The cause of the eye signs of exophthalmic goiter has led to much controversy Some students of the disease feel that changes in the orbital fat and extra ocular muscles account for some of the signs Muscle spasm may explain lid lag Others feel that stimulation of the cervical sympathetic trunks causes the signs Still others believe the pituitary thyrotropic hormone explains the changes

Unilateral exophthalmos may occur in tumors of the orbit either solid or vascular (Fig 46) *Pulsating* (with systole) *exophthalmos*

* Diminution of the power of convergence may occur without exophthalmos when it is associated with imbalance of the accommodative convergence reflex

a sebaceous cyst due to obstruction of the duct of a sebaceous gland (Fig 41) Cysts are not uncommon on the lid margins (Fig 42)

Blepharospasm produced by forcible contracture of the sphincter of the eyelids, occurs from several causes It is seen in children, who may also exhibit contraction of other muscles possibly as the result of emotional disturbance This type is called habit spasm,' or tic, of the eyelids Blepharospasm is present in extreme photophobia particularly when ocular inflammation causes the eye to become more sensitive than normal to light In the presence of photophobia the patient opens his eyes no more than necessary squinting very much

Fig 45 Ptosis and inability to raise upper lids in myasthenia gravis

as the normal person does in attempting to look directly at the sun (Fig 43) Constant irritation of the eye from any cause may produce it *Ptosis or drooping of an eyelid is due to paresis or paralysis of the* levator palpebrae superioris resulting from impaired function of the third cranial nerve This condition is frequently of congenital origin It may be seen in intracranial disturbances of hemorrhagic inflammatory or neoplastic etiology and in cervical sympathetic paralysis (Horner s syndrome) myasthenia gravis tabes dorsalis and multiple sclerosis (Figs 44 45) In facial paralysis (seventh nerve) the patient is unable to close the eyes this may be accompanied by *lacrimation* (see Fig 23)

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may be present when protrusion of the globe results from arterial aneurysm Infection or hemorrhage in the orbital tissue may also be the cause of protrusion of one eye At times there is no apparent reason for unilateral exophthalmos it may occur occasionally in hyperthyroidism

Enophthalmos or sunken eyes, is commonly found in wasting disease or in conditions associated with rapid fluid loss, as in dysentery, owing to loss of orbital fat or to dehydration, respectively Unilateral enophthalmos may be part of Horner's syndrome It may follow fracture of the orbital wall

Increased intra ocular pressure or hardness of the eyeball, palpated through the closed upper lid is encountered in glaucoma *Decreased intra ocular pressure, or softening* occurs in dehydration, examples being acute dysentery and diabetic acidosis

Movements Observations regarding movements of the eyeball, as well as of the eyelids, offer information concerning the integrity of certain of the cranial nerves The examiner quickly learns to evaluate lid signs by having the subject follow his finger upward and downward and to appraise ocular movements by directing the subject's gaze into the direction of synchronizing action of the extra ocular muscles

When either eye deviates so that its visual axis is no longer parallel with that of the opposite eye, the condition called 'squint,' or 'strabismus,' obtains Squint is classified according to whether the deviation is *divergent* or *convergent* (Figs 47, 48) It is further classified as *paralytic* and *nonparalytic* according to its cause

Squint or deviation of the visual axis of one eye from the other can be determined by the *Hirschberg test* This consists of having the patient gaze directly at a light held by the examiner The latter stands directly behind the light and observes the position of its reflections on the convex surfaces of the corneas If binocular fixation is present the location of the image on the cornea overlying the pupil will correspond to that on the fellow eye When only one eye is fixing its gaze on the light the reflection on the deviating eye will be displaced away from the central area of the pupil If the eye has a convergent deviation the reflection will overlie the lateral pupillary border the lateral rim of the iris, the limbus or the sclera depending on the degree of the angle of deviation The reverse position is found in divergent squint

This test is particularly helpful in doubtful cases of strabismus and in young children where the bridge of the nose has not fully developed and the epicanthal fold persists covering the sclera and giving the child the appearance of being cross eyed

Paralytic squint is due to neurologic disease and the resulting muscle imbalance In *paralysis of the sixth nerve* the eye does not rotate laterally as the patient looks directly ahead, the affected eye

Fig 47

Fig 48

Fig 47 Divergent strabismus of right eye
Fig 48 Convergent strabismus of left eye

turns inward a convergent or internal squint *Paralysis of the third nerve* prevents inward upward and downward rotation of the eyeball in forward gaze then a divergent or external squint is apparent in that the affected eye turns outward or laterally *Fourth nerve paralysis* prevents downward and outward rotation *Weakness* or *paresis* rather than paralysis is accompanied by some movement but less than on the unaffected side where overaction of the muscle synchronizing with the weakened one produces excessive rotation of the eyeball *Nonparalytic squint* is produced by a poor desire for binocular visual function No weakness of an extra ocular muscle need be present Errors in refraction sometime precipitate this type of strabismus The *divergent* and *convergent* squints due to disease give the same appearance as the nonparalytic ones illustrated in Figs 47 48

If upon lateral gaze there is set up a rhythmic limited back and forth movement of the globes *in* a horizontal plane it is spoken of as nystagmus The eyeball moves slowly in one direction and returns more rapidly in the opposite direction At times a *rotating nystagmus* occurs These reactions are associated with neurologic disease and point to disturbance in the vestibular apparatus that is of

the vestibular portion of the eighth nerve or to cerebellar disease It is met with at times in rare forms of congenital eye disease

In postencephalitic parkinsonism there may occur a forcible upward fixed spasm of the eyeballs lasting for minutes at times The patient is unable to relieve it These are known as *oculogyric crises* (Fig 49)

Fig 49 Oculogyric crisis

Sclera Because of the normally bluish white color the sclera offers an excellent place for noting certain color changes Thus icterus is commonly noted here first The slight yellow color of pernicious anemia of familial hemolytic anemia or other forms of hemolytic anemia may be observed The faint icterus associated with cholecystitis to the marked yellow and even dark green of obstructive

jaundice also will be obvious in the scleras The gray blue color is striking in those who have generalized argyria or in those having localized argyria because of the prolonged use of silver solution as eye drops In the rare hereditary abnormality of the mesenchyma the disease *fragilitas ossium* the scleras are blue in color owing to choroidal pigment showing through the abnormally thin sclera

Fig 50 Conjunctival opacity following severe conjunctivitis

Conjunctiva Either the bulbar or palpebral conjunctiva may provide valuable evidence of disease

A number of local inflammatory conditions give rise to *conjunctivitis* as shown by injection of the blood vessels causing redness swelling lacrimation at times pus and often photophobia or pain due to exposure to light (Fig 37) In some forms of inflammation lymphoid follicles are prominent in the conjunctiva Disease of the conjunctiva may be so severe as to result in marked thickening of the membrane and to lead to opacity of the cornea (Fig 50) Less severe inflammatory reactions occur in allergic states

In the aged one may see at times a yellowish triangular area in the conjunctiva on either side of the cornea caused by an excess of yellow elastic fibrous tissue and known as a pinguecula The *pterygium* is a triangular ingrowth of vascularized conjunctiva onto the cornea from the nasal side (Fig 51) It is supposed to be due to poor nutrition of the cornea because of an adjacent pinguecula or from long irritation as from exposure to drying and dust *Bitot s*

spots are triangular, gray areas thought to result from vitamin A deficiency

Conjunctival changes related to distant disease may be of diagnostic importance The *pallor of anemia* may be striking Jaundice gives a yellowish tint to the usual pink color In polycythemia, the pink gives way to a bluish red color The conjunctiva is a favorite spot for the clinician to search for petechiae in suspected subacute bacterial

Fig 51 Pterygium

endocarditis or other septicemias The bleeding tendency of purpura is often demonstrated in the conjunctivas by petechiae or ecchymoses In the collagen diseases ecchymosis is not unusual

Lacrimal Apparatus Swelling of the lacrimal gland was described in the section dealing with the eyelids (see page 182) Nasal infection may be followed by extension of the inflammation to the lacrimal sac, *dacryocystitis* This appears as a swelling at the inner canthus of the eye Tearing results from stenosis or blocking of the lacrimal ducts

Cornea With advancing years there may develop a grayish ring at the border of the cornea (It usually begins with upper and lower crescents to meet eventually to form a ring) This is the *arcus senilis* due to lipoid degeneration There is always a clear zone between the arcus senilis and the limbus (Fig 71, page 117) The Kayser Fleischer ring consists of greenish pigment at the edge of the cornea diagnostic

of Wilson s disease (hepatolenticular degeneration) Pinpoint calcium deposits in the corneal margin may occur in hypercalcemia

Acute inflammation may accompany ulceration of the cornea The latter commonly follows trauma from a foreign body in the conjunctival sac or from direct injury *Scarring* commonly remains as a residuum (Fig 52) Excessive drying of the cornea may occur in marked exophthalmos at times leading to ulceration Ulcers can be seen best when small with a hand lens The inflammation about the ulcer causes cloudiness of the adjacent portions of the cornea Continuous chronic inflammation of the limbus leads to a vascular membrane at this site the so called pannus *Chronic superficial inflammation* may occur without ulceration In the deeper layers of the cornea parenchymatous inflammation (*interstitial keratitis*) causes a ground glass appearance (Fig 53) The most common type is that due to prenatal syphilis less often it is caused by tuberculosis Syphilitic keratitis leaves *vascularization* of the cornea so that a network of small vessels remains for life this may be seen by a slit lamp or with the + 20 lens of the ophthalmoscope

Vitamin A deficiency may cause *keratotic changes* in the epithelium covering the cornea The cornea then loses its luster and becomes cloudy and ulceration may occur In the advanced state rarely seen in the United States it leads to opacity and ulceration so called *xerophthalmia* Riboflavin deficiency may be accompanied by an ingrowth of vessels from the limbus visible with the slit lamp The *corneal reflex* is lost in sensory disturbances of the trigeminal nerve and often in cerebellopontine angle tumors because of a break of the arc either in the fifth or in the seventh cranial nerves

Iris Although it has been noted that the color may vary in the two eyes in the normal person pigmentary changes may occur also as part of inflammation or may represent its residuum The abnormal *pigmentation* may affect the whole iris or it may be merely piebald or spotty Pigmented areas may become the *site of a neoplastic growth* a *melanoma* In hypercalcemia calcium may be deposited in the iris (Fig 54)

Inflammation of the iris is termed *iritis* This disease may be produced by a variety of causes Among these are syphilis in which it may occur as a manifestation in the secondary stage or as a late

benign lesion In tuberculosis the tubercle may be seen growing upon the pigmented membrane In gonorrhea and occasionally in absorption from other distant septic foci possibly diseased tonsils accessory nasal sinuses dental abscesses and the like iritis may be a complication Whatever the cause, the lesion probably represents an allergic response due to tissue sensitivity to the products of an infectious agent The *iris is swollen the pupil is contracted with sluggish reflexes* and there is usually a circumcorneal narrow zone of pink or lavender colored hyperemia *Photophobia* is usually severe because of the attempted constriction of the swollen iris in the light reflex (Fig 43)

Fig 52 Corneal scar

Pupils As the result of iritis and adhesions of the iris to the anterior lens capsule the pupil may be *irregular* and may remain permanently of the same size Because of these synechiae *it cannot respond reflexly to light or to accommodation*

Mydriasis Dilatation of the pupil occurs in the blind because of failure to respond to light It is common in near sightedness (*myopia*) *Miosis* or pupillary constriction may be part of the picture *of iritis because of swelling it may also be found in* farsightedness (*hyperopia*) It may occur with old age (Fig 30)

The size of the pupil and its reactions or failure of reactions are related commonly to its nervous mechanism Therefore the pupillary *examination actually is an important item in the neurologic* examination if one remembers that dilatation is mediated through the thoracicolumbar (sympathetic) portion and constriction through the craniosacral (parasympathetic) portion of the autonomic nervous system

Thus *mydriasis* is found in coma certain stages of anesthesia hysteria and fright optic atrophy and certain diseases of the brain Paralysis of the third nerve irritation of the cervical sympathetic fibers found at times in disease of mediastinal structures or because of a cervical rib and tickling of the neck may cause pupillary dilatation Drugs may act through a nervous influence as a mydriatic

Miosis Miosis occurs as the result of irritation of the oculomotor nerve or its center and also of paralysis of the cervical sympathetic fibers due to mediastinal or cervical disease (Horner s syndrome

Fig 53 Interstitial keratitis due to prenatal syphilis

resulting from such a paralysis consists of changes on the affected side namely a constricted pupil ptosis of the eyelid enophthalmos flushing and temperature change of the skin of the face) The constricted pupil may also be part of the clinical picture of multiple sclerosis general paresis meningitis and meningeal irritation and of cerebral or pontine disease Certain miotic drugs used locally may cause pupillary constriction

The commonest circumstances under which miosis is of great general significance are two One is the pinpoint pupil of opium poisoning a most valuable clue to morphine addiction The other is the constricted and irregular *Argyll Robertson pupil* practically pathognomonic of tabes dorsalis (Fig 55)

In Cheyne Stokes respiration the pupils may dilate during dyspnea and constrict during apnea

Anisocoria Occasionally, pupils of unequal diameter are met with as a congenital anomaly Pupillary inequality usually signifies disease of the nervous system Thus anisocoria is commonly encountered in neurosyphilis and in other focal cerebral disease, or in multiple sclerosis (Fig 30)

Fig 54 Calcium deposits in iris (indicated by arrows) in a case of Burnett s syndrome

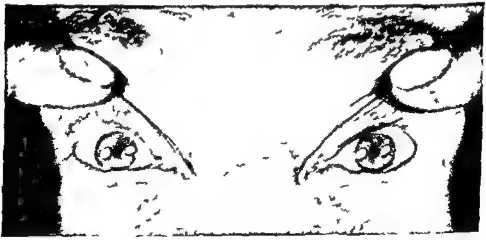

Fig 55 Argyll Robertson pupils in tabes dorsalis Pupils are irregular and miotic

Pupillary Reflexes The technic and normal reactions have been described in Chapter 5

The immobile pupil is one which reacts neither to light nor to accommodation The *Argyll Robertson pupil,* mentioned above is characterized by altered reflex reactions as well as by being irregular

and miotic This pupil fails to react to light but does do so to accom modation In its earlier stages it merely may be sluggish in its reac tion to light in one or both pupils later to become the fully established Argyll Robertson pupil This abnormality of the pupillary reflex is found most often in tabes dorsalis and less commonly in general paresis encephalitis and chronic alcoholism Neurologists disagree as to the site of the break in the reflex arc

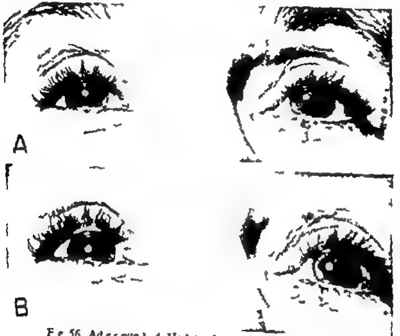

Fig 56 Adie s pupil A Unilateral tonic pupil B Constriction following instillation of mecholyl

The *tonic pupil of Adie s syndrome* must be differentiated from the Argyll Robertson pupil It is not miotic often larger than its fellow and with apparent complete loss of the light reaction (Fig 56) However after a period in the dark the pupil dilates and then will react to light (In the complete Adie s syndrome the patellar and Achilles tendon reflexes are absent) The cause is unknown

Paradoxical pupil is one in which the reflexes are the opposite from the expected that is dilation to light and/or accommodation is occa sionally met in tabes dorsalis

In ocular disease the normal consensual reaction, as described in Chapter 5 is applied as the *indirect reflex* It occurs in disease of the optic nerve or tract Though there is no direct light reflex when light is thrown into the diseased eye it does react when light is directed to its fellow The oculomotor system must be intact for this reflex

Hippus' is the term applied to alternate constriction and dilatation of the pupil when exposed to light Though it may occur in normal persons it is seen often in hysteria meningitis disseminated sclerosis and other neurologic diseases

Lens Cataract is the only abnormality of the lens which can be recognized by the gross methods used in the general physical examination Such opacity of the lens whether of congenital origin or from trauma intense heat hypoparathyroidism diabetes mellitus or senility may be quite obvious by the grayish white color of the pupil rather than the usual black The cataract can be studied best with the positive lenses of the ophthalmoscope This instrument is capable of demonstrating finer abnormalities of the lens also

As another manifestation of deficiency of the structures derived from the mesenchyma dislocation of the lens may be found in the rare condition known as Marfan's disease' A weak suspensory ligament permits the lens to be dislocated The patient shown in Fig 2 page 65, had this difficulty

Fundus Funduscopic examination must be part of every general examination especially if vascular or neurologic disease is anticipated The retina is subject to changes in a number of systemic diseases and often gives the first clue (The ophthalmologist uses the ophthalmoscope also in examinations for refractive errors and intrinsic eye diseases) Here we are interested only in the systemic diseases with accompanying retinal changes as the few following examples will indicate (Detailed description and illustrations of these and many more may be found in textbooks of ophthalmology)

The *color* of the retina may by its pallor suggest anemia and by its abnormal dusky redness anoxemia or polycythemia the latter being accompanied by engorged vessels

Hemorrhage into the retina may accompany anemia especially from sudden massive blood loss purpura scurvy leukemia and septicemia Petechiae of subacute bacterial endocarditis may be seen

In nephritis and hypertensive vascular disease *hemorrhagic retinopathy* may appear with flame shaped hemorrhages due to vascular rupture *Exudate* in the retina may develop in nephritis as *albuminuric retinopathy* with or without hemorrhage The exudate is recognized as whitish areas along the retinal vessels The term cotton wool is often used to describe these white areas of exudate which represent the effects of impaired nutrition or anoxemia of the retina

In diabetes mellitus there may be exudate and smaller hemorrhages providing the picture of *diabetic retinopathy* Very rarely one sees moving fat globules in the vessels in diabetic lipemia and in fat embolism following fractures of bones *Leukemia* may account for deposits of leukocytes in the retina Inflammatory exudate may occur in syphilis and other infections this is known as chorioretinitis After the absorption of exudate from such areas and healing pigmented scars result due to visibility of the choroid coat *Tubercles* in the retina are seen rarely in miliary tuberculosis

The nerve head or optic disc may be swollen and then is designated as papilledema or choked disc Such swelling occurs whenever the venous or lymph return is obstructed by any condition within the orbit itself or within the skull It is expressed in diopters corresponding to the power of the ophthalmoscopic lens needed to visualize the disc The disc may be white representing *optic atrophy* a loss of optic tract fibers as found in instances of tabes dorsalis multiple sclerosis and other neurologic diseases

Nose

Skin Changes in the skin of the nose are usually obvious A few constitutional diseases are accompanied by changes of the skin of the nose and adjacent areas The dusky red infiltrated lesions of lupus erythematosus show a *butterfly shaped* involvement of the bridge of the nose and adjacent portions of the cheeks A similar pattern is apparent at times in leukemic infiltration of the skin in myelogenous leukemia Purpuric spots may accompany leukemia cutis Likewise the embolic petechiae at times appearing in coccal septicemia may assume a butterfly distribution These patterns can be accounted for on the basis of the vascular distribution (Fig 14)

In adolescence coincident with the appearance of the gonadal hormones, there occurs an increased secretion by the sebaceous glands of the skin (Fig 87) The alae nasi commonly become the site of *comedones* (blackheads) With advanced riboflavin deficiency, it is

Fig 57 Rhinophyma

Fig 58 Basal cell carcinoma

said that the pores of this region also may become dilated filled with plugs of desquamated epithelium and present a gray thin scaling of superficial epithelium

In uremia, the perspiration over the nose may evaporate to leave a deposit of urea *uremic frost*

The skin of the nose is a favorite site for dilated vessels in the chronic alcoholic addict leading to the notorious red nose Dilated venules and spider angiomas at times are prominent here in portal cirrhosis A *dusky red thickened skin* of rosacea characterized by hypertrophy of the sebaceous glands and dilated pores may lead to a bulbous nose called *rhinophyma* (Fig 57) The skin of the nose also may be the site of an *epithelioma* (Fig 58)

Fig 59 Nasal deformity from fracture of septum

Movement Only in air hunger best exemplified in lobar pneumonia does one see *movement of the alae nasi* to increase the diameter of the nostril *synchronous with the inspiratory cycle* of respiration This represents the only residual movement of the nostrils from more primitive days

Contour Changes in the contour of the nose from the normal may be prominent and plainly indicative of past injury or disease Of these fracture of the nose is the most frequent Fracture of the septum in healing may lead to deviation to one side or the other changing the normal alignment (Fig 59) Healing of a badly fractured septum

Fig 60 Saddle nose resulting from syphilitic disease of septum

may cause a hump in the middle third of the nose If the cartilagino portion of the septum has been crushed the nose often heals wi flattening at its tip Fracture of the nasal bones may lead to a flatten and depressed bridge

Fig 61 Deformity due to syphilitic destruction of cartilaginous septum

The child who has obstruction from enlarged adenoids and must therefore breathe through his mouth develops a characteristic malformation Such a nose is thin with very small nasal passages because of disuse, this type of nose is a prominent feature in the so-called adenoid facies (High arching of the palate is also part of the picture)

The most frequent disease leading to nasal deformity is syphilis The septum in its upper portion may be the site of a gumma in either

Fig 62 Gummatous osteitis of nasal bones

the acquired or prenatal form of the disease Because of resulting bone destruction the bridge caves in causing the so-called saddle nose (Figs 60 61 see also Fig 67 *page 114*) Rarely gumma of the nasal bones ulcerates externally (Fig 62)

Nasal Passages Inspection of the nasal passages may show the pale boggy appearance characteristic of *allergic rhinitis* as the result on edema of the mucosa In *anoxemia* the mucosa is bluish in color Small *furuncles* may at times be seen within the nostril owing to infection of hair follicles The moist denuded lining of the nostril seen in some prenatal syphilitic children is the cause of the so called

snuffles Not uncommonly, the physician or student will examine the nasal mucosa to find dilated vessels and less often small *hemangiomas (in some instances of familial origin)*, at other times, these may present bleeding points, a most common cause of *epistaxis*

Examination of the *septum* promptly reveals deviation to one side or the other, if present Occasionally, a tumor (osteoma) may be seen on the septum *Spurs* are projections which occur from trauma or at the junction of the bony and cartilaginous septums

Ulceration of the septum occurs at times in acute and chronic infection, and upon exposure to certain toxic chemicals and metals A striking finding is *perforation* of the septum, the defect varying in size from several millimeters to a centimeter and more in diameter The most common cause of perforation from disease is the syphilitic gumma At times nonsyphilitic ulceration may lead to osteomyelitis and perforation The pressure from a sprouting bean or pea inserted into his nostril by a child may lead to atrophy of the mucosa and bone resulting in a defect Many septal perforations encountered by the examiner date to the days when submucous resection operations were in vogue Rarely will one see perforation of the cartilaginous septum due to exposure to salts of chromium

Atrophic rhinitis characterized by a dry pale mucosa and emitting a bad odor (*ozena*) is an inflammation of unknown cause

Anosmia (lack of smell) results most often from disease of the frontal lobes of the cerebrum as in tumor, or following fractures involving the frontal bone in the region of the cribriform plates

Lips

The lips commonly show evidences of disease both constitutional and local

Color is often significant The pallor of anemia may be noteworthy, so much more significant than a pale skin because of the greater capillary supply In anoxemia as may be seen in pneumonia and in heart failure the lips are of a bluish tint In the polycythemia of congenital heart disease they may be almost purple (Fig 1, page 441) In polycythemia vera the lips are dark but more red than blue Carbon monoxide poisoning causes a bright, cherry red color

Fig 63 Pigmentation of lips and tongue in Addison's disease

Fig 64 Cheilosis

Fig 65 Fissures of prenatal syphilis

Fig 66 Angioneurotic edema of upper lip

Fig. 67 Swelling as result of sensitivity to lipstick

Fig 68 Herpes simplex Vesicles involve upper lip extending to nostrils

The lips may partake of the brown or bluish black pigmentation occurring in the mucosal surfaces in Addison's disease (Fig 63)

Drying of the lips from wind or from fever causes scaling and often fissures The same may follow exposure to severe cold *Fissures* at the angles of the mouth occur not uncommonly in elderly people with poorly fitting dentures which permit the upper lip to overhang the lower, thereby leaving a furrow at this point The skin in this

Fig 69 Syphilitic chancre of lip

crease is macerated by saliva and thus becomes fissured In riboflavin niacin, and iron deficiency, fissuring may occur also at the angles of the mouth, this is spoken of as 'cheilosis (Fig 64) Angular fissuring may result from infection, syphilis of prenatal origin being a good example (Fig 65) These are spoken of as rhagades Healing occurs leaving white radiating scars which may be of diagnostic aid years later *In acquired syphilis,* mucous patches at the same site may produce fissures, covered by a thin gray membrane

Swelling or *edema* of the lips may be part of the generalized water retention in renal disease Edema may be sharply localized to one or both lips as an allergic manifestation or as angioneurotic edema, both resulting from increased capillary permeability (Figs 66 67)

Fig. 70 Scarring due to late syphilis

Fig 71 Leukoplakia.

Fig 72 Epithelioma of lip

Fig 73 Unilateral harelip

There are several *inflammatory diseases* of the lips The lesion of *herpes simplex* (cold sore) occurring at the vermilion line not infrequently accompanies febrile diseases especially lobar pneumonia First a cluster of vesicles appear to rupture later with a resulting crust of dried serous secretion (Fig 68) The lips may be the portal of entry of the *Treponema pallidum* of syphilis producing the firm often crusted ulcer characteristic of the primary sore or *chancre* (Fig 69) In the secondary stage of the disease labial *mucous patches* may be found slightly elevated grayish white plaques of mucosa several millimeters or more in diameter (see Fig 87) Rarely the scars of healed tertiary lesions may be found (Fig 70) The painful shallow ulcers having a red base of *tuberculous* origin are rare except in the sanatorium for tuberculous patients where there are more examples of late disease

The lips are favorite sites for the embolic *petechiae* of subacute bacterial endocarditis The small red papules of *hereditary telangiectasia* on the lips tongue and nasal mucosa may be the site of recurrent bleeding The dry lusterless grayish plaques of *leukoplakia* are seen occasionally They may occur *especially on the lips* of pipe smokers and those who carry snuff in the labiogingival fold (Fig 71) As the result of long standing irritation due to pipe smoking or a rough dental filling an *epithelioma may arise as a* firm growing chronic ulceration of the lip (Fig 72)

Movements of the lips may be significant The sagging of the angle of the mouth because of muscular *weakness on* one side is part of the picture of paralysis of the facial nerve either supranuclear or infranuclear (Fig 23) Tremor of the lips may be noted in general paresis chronic alcoholism thyrotoxicosis and *emotion* and in a few other neurologic disturbances

Of developmental anomalies the harelip single or double may be seen in infancy or the scar indicating its repair may be seen in the older subject (Fig 73)

Mouth

GUMS AND TEETH

Teeth *Dentition* may be delayed in childhood owing to rickets or prolonged illness The teeth may be irregularly spaced or over

Fig 72 Epithelioma of lip

Fig 73 Unilateral harelip

lapping because of crowding in a dental arch which is too small This is common in the mouth breather from adenoid hypertrophy Either the upper or lower teeth anteriorly may override, producing *malocclusion* This may occur because of developmental abnormalities, rachitic or otherwise or following fractures of the jaw with imperfect reduction

Fig 6 Dental caries worn teeth and swelling and gingival retraction of pyorrhea alveolaris

The *color* of the teeth is variable They may show the unusual yellowish brown mottling one finds in persons who grew up in areas where the water supply contained excessive quantities of fluorine (Fig 74) Commonly teeth are found to be stained yellow owing to tobacco chewing or snuff dipping *Tartar deposit* mainly due to calcium salts of the saliva is encountered in variable amounts Often as might be expected because of its origin it is heaviest about the upper molars opposite Stensen s duct and on the inner aspect of the incisors adjacent to the ducts of the submaxillary and sublingual salivary glands

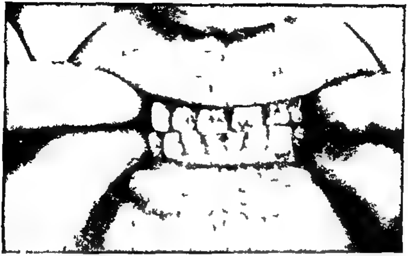

Fig 74 Dental mottling due to fluorine

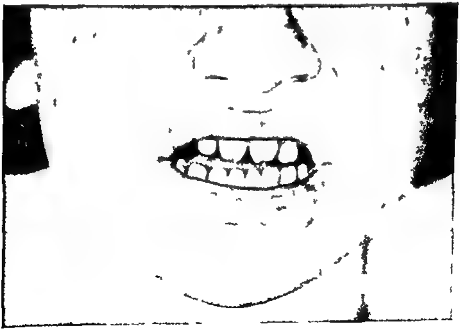

Fig 75 Hutchinsonian teeth (Kampmeier R H Essentials of Syphilology J B Lippincott Co)

the sockets by bleeding in the periodontal membrane they may drop out or be removed easily

At the time the third molars appear in young adult life they must be observed for *impaction* because of insufficient room in the dental arch for normal eruption They may erupt at an angle to the others or even at right angles to the second molar the eby causing marked

Fig 78 Gin ival swelling toxic result of dilantin therapy

pressure on all the teeth of that side of the arch with resultant mechanical effects and pain

Gums The most common abnormality of the gums is retraction at the margins away from the teeth This accompanies the deficiency disease of scurvy even of the mild variety More often it is present with infection *pyorrhea alveolaris* With gingival retraction there is some attendant absorption of the alveolar process so that the neck and a portion of the dental root may be exposed below the enamel

Upon inspection of the teeth, certain abnormalities in configuration may be striking The most outstanding are the *hutchinsonian teeth* of prenatal syphilis Because the tooth buds of the permanent incisors and sixth year molars are formed in the early weeks of life, they are affected by active syphilis and characteristic stigmas may result The upper central incisors, and less often the other incisors show, soon after eruption, an enamel defect in the biting surface Soon this erodes to present a notch In addition, the teeth are widely spaced

Fig 77 Infiltration of gums in monocytic leukemia

rounded, peg shaped or may have a screw driver type of taper (Fig 75) *The first molars may show poorly developed cusps* with thin enamel The rounded cusps of these teeth explain the term 'mulberry molars the enamel becomes eroded with early decay Thus carious shells of first molars in children should suggest *prenatal syphilis*

The biting or occlusive surfaces of teeth wear down with the passage of years so that the enamel is worn off the cusps laying bare the core of dentin—this is common after middle life (Figs 76 97)

Dental caries or decay with cavity formation, is common in poor dentition due to rickets and other dietary deficiencies More commonly dental caries is of unknown origin (Fig 76) The examiner should make note of caries of dental repair work as evidence of past caries and of dental extractions In *scurvy* the teeth are loosened in

In the case of an improperly erupting third molar, a flap of gingival tissue may overlie the tooth to catch beneath it food particles and other debris leading to inflammation and painful swelling

Insoluble lead and bismuth (the latter used in antisyphilitic treatment) may be deposited about 0 5 mm back from the actual gum margin appearing as a bluish black line, called the lead or bismuth line The use of a hand lens reveals that this is not a continuous line but that it consists of many pinpoint dots Such a line can be

Fig 80 Gingival bleeding due to scurvy

differentiated from discolored tartar deposits under the gingival border by slipping a thin cardboard or paper fragment between the teeth and the gum margin This offers a white background for the gum margin If the border shows no black discoloration the source of the color is the stained tartar Rarely bismuth is deposited in larger slate blue splotches in the gums away from the margin

The gingival mucosa is a favorite site for *petechiae* in septicemia Petechiae and larger extravasations of blood appear in the gums in purpura of whatever origin Bleeding commonly appears from the gum margins in both primary and secondary purpura because the delicate membrane is so easily injured (Fig 79) Scurvy is also associated with a bleeding tendency (Fig 80) The pigment deposit of Addison s disease may be more prominent in the gingival mucosa than elsewhere in the oral mucosa

level In *pyorrhea alveolaris* the gum margins are spongy, red, painful, and bleed easily The gums are retracted from the teeth, pus exuding from the space between the gum and the teeth (Fig 76) This is easily demonstrated if the examiner will press on the gum margin with a tongue blade Tartar deposits and/or possibly inadequate amounts of vitamin C in the diet in some cases at least, probably account for this condition aggravated by secondary infection by mouth organisms

Fig 79 Bleeding of gums in thrombocytopenic purpura

Vincent s angina caused by *Borrelia vincentii* and *Fusobacterium plauti-vincenti* presents fiery red swollen, exceedingly painful gums, commonly associated with fever A white membrane of exudate usually is found on the affected gums The gums may present a noninflammatory swelling in *leukemia* especially of the monocytic variety because of the massive submucosal invasion by abnormal cells (Fig 77) The gums may be so hypertrophied as to reach the level of the occlusal surface of the teeth This condition may be closely simulated as a reaction to *dilantin* therapy (Fig 78)

The *epulis* is a fibrous tumor of the gum usually arising from the bone or periosteum of the jaw (Fig 81)

Pressure on the gums by an ill fitting removable bridge may lead to atrophy of the gingival mucosa and underlying alveolar process The atrophy of the latter which always occurs following dental extraction accounts for the deep depression of the gum line at the site of extractions

TONGUE

The size of the tongue may deviate either way *Macroglossia* or a large tongue may be a congenital anomaly an inflammatory swell

Fig 82 Macroglossia of acromegaly

ing may be due to the deposit of amyloid or the generalized myxedematous tissue infiltration of hypothyroidism or a part of the splanchnomegaly of acromegaly (Fig 82) If the tongue is edematous indentations may appear at its borders representing a pattern of the teeth owing to their pressure against the tongue A small tongue or *microglossia* may follow neurologic disease as in paralysis of the hypoglossal nerve bulbar palsy or undernutrition

The mucosa of the gums is a common site of the vesicles of *herpetic stomatitis,* or the solitary vesicles due to food sensitivity or accompanying the menses After the vesicle breaks, it leaves a superficial, painful ulcer surrounded by a narrow red border, the *canker sore,* usually of several millimeters in diameter

The mucous patch of secondary syphilis frequently occurs on the gum It appears as a grayish white area of slightly elevated mucosa (comparable to the papule of the skin) from several millimeters to a centimeter in diameter The surface often is denuded or can be removed easily with the tongue blade, leaving a denuded area appearing much like the canker sore but usually painless and lacking the red border *Tuberculous ulcers* are not seen as frequently on the gums as elsewhere in the mouth

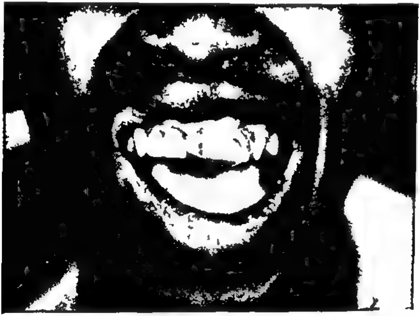

Fig 81 Epulis

A *periapical abscess* at the root of the tooth causes local osteomyelitis accompanied by a painful inflamed swelling at the base of the gum This is known as a gum boil This may break, drain pus and leave a sinus tract from which pus can be expressed by pressure with the tongue blade

The *epulis* is a fibrous tumor of the gum usually arising from the bone or periosteum of the jaw (Fig 81)

Pressure on the gums by an ill fitting removable bridge may lead to atrophy of the gingival mucosa and underlying alveolar process The atrophy of the latter which always occurs following dental extraction accounts for the deep depression of the gum line at the site of extractions

TONGUE

The size of the tongue may deviate either way *Macroglossia* or a large tongue may be a congenital anomaly an inflammatory swell

Fig 82 Macroglossia of acromegaly

ing may be due to the deposit of amyloid or the generalized myxedematous tissue infiltration of hypothyroidism or a part of the splanchnomegaly of acromegaly (Fig 82) If the tongue is edematous indentations may appear in its borders representing a pattern of the teeth owing to their pressure against the tongue A small tongue or *microglossia* may follow neurologic disease as in paralysis of the hypoglossal nerve bulbar palsy or undernutrition

Probably, one of the first things to strike the attention upon examination of the tongue is the *color* The pallor of anemia is readily recognized as is also the duskiness of cyanosis as was described in the section regarding the lips In scarlet fever, the tongue is intensely red, the papillae standing out as white dots as a result, the appearance leads to the term of 'strawberry tongue' The redness

Fig 83 Papillary atrophy of macrocytic anemia

due to *glossitis* in several deficiency states is striking and is associated with papillary changes Thus in *macrocytic anemia* the tongue may be red and painful more commonly this is limited to the borders of the tongue and its tip, though the whole tongue may be involved The papillae are flattened or absent (slick tongue") since they partake of the general atrophic process in the gastrointestinal tract, which extends from the tongue to the anus this is commonly found in

pernicious anemia for example Such a tongue is of diagnostic importance in pernicious anemia and in sprue (Fig 83) In *niacin deficiency* (pellagra) the tongue is often beefy red painful swollen and with complete papillary atrophy In the instance of glossitis either of the macrocytic anemia or of the pellagragenic type ulceration may take place *Riboflavin deficiency* is said to give a magenta colored tongue which also is smooth because of papillary atrophy

Fig 84 Black tongue because of fungous growth

A red sore tongue, accompanied by difficulty in swallowing is the so called "Plummer Vinson syndrome due to iron deficiency

Papillary atrophy without glossitis may be encountered in persons wearing upper dental plates

If the color of the tongue has not been unusual the examiner s attention has probably been attracted by the *coat* In the dehydration of febrile disease aggravated by mouth breathing the tongue is not cleansed by saliva therefore the desquamated epithelium and other debris may collect in a thick prominent coat The coat is also out

Fig 85 Geographic tongue of unknown cause

Fig 86 Syphilitic chancre of tongue (Kampmeier R H Essentials of Syphilology J B Lippincott Co)

Fig 87 Mucous patches of secondary syphilis on under surface of tongue
Note comedones of skin

Fi- 88 Early carcinoma of tongue

standing at times in smokers and in alcoholic patients, especially on the "morning after the night before" again partially an effect of dehydration The coat may be discolored owing to tobacco, fruit juices, and other extraneous causes

Fungus infections may produce a coat by the growth of the matted mycelian threads The white growth found most often in infants is *thrush* Occasionally in adults a black coat is found usually caused by *Aspergillus niger* (Fig 84) The grayish white membrane of diphtheria and of Vincent's stomatitis may involve the tongue

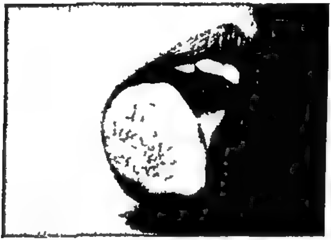

Fig 89 Gumma of tongue

The surface of the tongue in general has given rise to certain descriptive terms Thus, the 'geographic tongue' is one in which there are curious circinate patches of mucosal atrophy healing at one site and extending elsewhere Whether this condition is an evidence of malnutrition is debatable (Fig 85) Moeller's glossitis is very similar possibly the same process, whatever the cause may be

Ulceration of the tongue occurs in several diseases That which at times accompanies deficiency stomatitis was mentioned above The most common cause is herpetic vesicles with the development of *canker sores* as described in the case of the lips and gums They are found either at the tongue margin or on the under surface of the tongue Vincent's infection also may lead to painful ulceration The *chancre* of syphilis may present itself as a hard, painless ulcer (Fig

86) Much more frequent, however, are the *mucous patches* of secondary syphilis Those at the tongue margins or on its under surface are the same as those described for the gums and lips (Fig 87) Mucous patches on the dorsum of the tongue differ somewhat from those elsewhere on the oral mucosa The papillae atrophy in the area of the mucous patch and thus a depression remains after healing of the patch until the papillae are re established Such areas may be most suggestive of the diagnosis In patients with advanced pulmonary tuberculosis the shallow pink exceedingly painful *tuberculous ulcers* may be seen occasionally

Fig 90 Benign papilloma of tongue

The *gumma* is a rare form of inflammatory tumor usually appearing as a unilateral mass deep in the tongue and causing asymmetry (Fig 88) Often it breaks down to ulcerate and heals with scarring and the production of unilateral atrophy

A dental snag a rough dental filling or inlay or a rough bridge may produce by constant *irritation* an ulceration occasionally the basis for an *epithelioma* Carcinoma of the tongue is usually recognized first as a painful firm ulcer refusing to heal and extending slowly (Fig 89) Of *benign tumors* there are fibromas papillomas neurofibromas and angiomas (Fig 90) *Thyroglossal duct cyst* or thyroid adenoma may appear in the vertical portion of the tongue (Both are embryonal rests)

Fig 91 Leukoplakia involving the whole dorsum of tongue

Fig 92 Deviation of tongue to right and atrophy resulting from paralysis of hypoglossal nerve

The lusterless gray plaques of *leukoplakia* are not uncommon on the tongue (Fig 91) A number of skin diseases have glossal manifestations erythema multiforme pemphigus and lichen planus are outstanding examples

Pigmentation of the mucosa is seen at times The gray blue splotches of bismuth deposit may be seen in the tongue as well as in the gingival or labial mucosa In Addison s disease deep brown pigmentation may be present in spots (Fig 63)

The *movement* of the tongue is important in diseases of the nervous system Paralysis of the hypoglossal nerve produces deviation to the involved side It is followed by muscular atrophy and a decrease in size of the affected side of the tongue if the lesion is peripheral (Fig 92) This may appear also in multiple sclerosis syringomyelia and in amyotrophic lateral sclerosis In hemiplegia due to a supranuclear lesion the tongue occasionally may deviate upon protrusion to the affected side being pushed over by the uninvolved tongue muscles Hemiatrophy of the tongue may accompany hemiatrophy of the face In myasthenia gravis the patient may be unable to protrude the tongue A fine tremor of the protruded tongue occurs in thyrotoxicosis general paresis and chronic alcoholism

Instances will be seen in which the tongue cannot be protruded because of a short frenum The patient is spoken of as being tongue tied there is usually lisping speech under such circumstances

BUCCAL CAVITY

The comments already made regarding the mucosa of the lips gums and tongue may be applied to the mucosa of the inside of the cheeks the hard and soft palates and the tonsils Thus the *pallor* of anemia and the yellow tint of *jaundice* may be readily noted The dusky red of polycythemia and the bluish color of anoxia are evident here also The black dots of *pigment* in Addison s disease or its more diffuse bluish black pigmentation may occur in the buccal mucosa and over the palates as well as on the lips gums and tongue The slate blue splotches of bismuth intoxication may be seen rarely in these areas

The *petechiae* of embolism in subacute bacterial endocarditis or in septicemia as well as the petechial hemorrhages and ecchymosis

of purpura, leukemia, and the like, may occur anywhere in the buccal mucosa. Translucent elevations, 2 or 3 mm in diameter, may be found in the buccal mucosa at times. These represent *mucous retention cysts* (Fig 93)

The vesicles of *aphthous stomatitis* with resulting canker sores and of herpetic stomatitis may occur at any site in the buccal mucosa with characteristics as described for the lips and gums. Likewise, the mucous patches of secondary syphilis, infection with thrush in infants, Vincent's infection, and tuberculous ulcers may be encountered as described before. The latter are possibly more likely to be found on the soft palate than anywhere else in the mouth

Fig 93 Mucous retention cysts of buccal mucosa

The syphilitic *chancre* is found less often within the buccal cavity than on the lips. Nevertheless such primary ulcers are encountered occasionally on the tonsil, where a firm indolent chronic ulcer *should raise this possibility for diagnosis*

Certain inflammatory conditions are more likely to involve specific areas of the buccal mucosa than of others heretofore mentioned. Thus the membranes of diphtheria, streptococcic infection, Vincent's infection, and scarlet fever find as a favorite area the mucous membrane of the soft palate and of the tonsils. Streptococcic infection is characterized especially by white patches of exudate over the tonsillar surfaces, which also may fill the crypts, so called follicular tonsillitis (Fig 94). Very early in almost all cases of measles, the

observer may find the pathognomonic *Koplik's spots* on the buccal mucosa opposite the first molar teeth They appear as a bluish white pinpoint spot surrounded by a red areola

Under acute inflammatory disease, one should point out that in *acute tonsillitis* not only may one note the exudate on the surface of

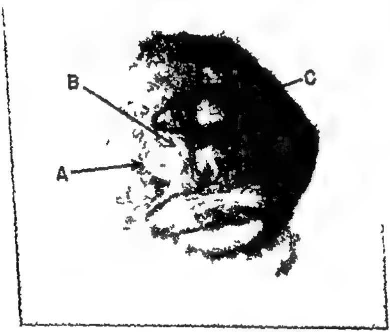

Fig 94 Acute tonsillitis A Swollen anterior pillar B Exudate (membrane) on tonsil C Edematous uvula.

the tonsil but one will also find diffuse redness of the tonsillar area and soft palate with inflammatory edema of these structures and enlargement of the tonsils so that they may almost meet in midline (Fig 94) If the infection extends outside the tonsillar capsule to form a *peritonsillar abscess* (quinsy) the swelling of the fauces and of the half of the soft palate on the affected side is extreme The inflammatory swelling actually may reach to or beyond the midline

Fig 95 Perforation of soft palate as result of syphilitic gumma

Fig 96 Gummatous osteitis of hard palate with perforation

In *agranulocytosis* with loss of leukocytic protection, extensive and deep ulceration of the tonsillar faucial and pharyngeal regions may occur Bleeding may result from an extension into blood vessels

Of chronic forms of inflammation tuberculous ulceration has been mentioned The syphilitic *gumma* finds a favorite site in the soft palate appearing as a relatively painless swelling which breaks down to form a chronic ulcer almost always ending in a *perforation* of the palate which remains after healing (Fig 95) Other than perforation

Fig 97 Carcinoma of buccal mucosa Note worn teeth

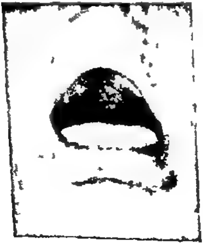

Fig 98 Carcinoma of hard palate

Fig 99 Sarcoma of soft palate

Fig 100 Cyst of floor of mouth

of the soft palate as an operative accident at tonsillectomy syphilis is essentially the only cause of such a defect In the hard palate the gumma usually begins in the palatal bones or in the periosteum of these bones to lead to ulceration and perforation (Fig 96)

At the line of bite on the buccal mucosa a white line or ridge is often seen which represents *leukoedema* of unknown cause There is reason to believe it may be a forerunner of leukoplakia or keratosis The gray plaques of *leukoplakia* as described before may be found

Fig 101 Cleft palate Note scar from repair of harelip

on the buccal mucosa of the cheeks especially and over the hard palate at times (Fig 71)

Ulceration of the buccal mucosa may be due to chronic irritation of a rough dental filling or bridge *Malignancy* may be superimposed (Fig 97) The carcinomatous lesion is hard painful and slowly progressive in growth (Fig 98) The tonsil may be the site of a *lymphosarcoma* Such a tumor because of ischemic necrosis and infection commonly develops into a sloughing bleeding ulcer (Fig 99)

A similar picture may appear bilaterally in acute lymphatic leukemia because of massive lymphoid hyperplasia Bleeding difficult to control is common under such circumstances

Benign *tumors* and *cysts* may be found at times in the mucosa The latter may originate in the mucosal glands or adjacent structures (Fig 100) Benign tumors may be fibromas neurofibromas, and the like

Palpation of the cheek, between the index finger inside and the thumb outside may be used at times to feel a calculus in Stensen s duct

The *uvula* may be unusually long and tickle the back of the tongue causing cough The congenital anomaly of *cleft palate* may be met in the hard palate (Fig 101)

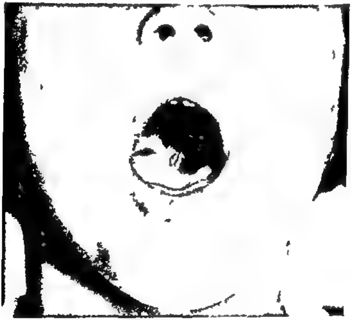

Fig 102 Paralysis of soft palate on right side

Movement of the soft palate is dependent upon the function of the ninth and tenth cranial nerves If paralysis is present the palate sags on the affected side and the uvula is pulled to the unaffected side movement on phonation is lacking on the paralyzed side (Fig 102) Water and food may enter the nose upon deglutition Diphtheritic neuritis basilar brain tumors and bulbar paralysis provide examples of palatal paralysis

The absence of the *palatal reflex* is common in hysteria in paralysis of the palate and in anesthesia due to disease of the second division of the fifth cranial nerve

PHARYNX

Almost all the comments made above concerning diseases of the buccal cavity may be applied to the oropharynx This is true regarding the color inflammations and ulcerations of the mucosa A few points may be repeated for emphasis and because of some variation

Inspection of the oropharynx at times reveals purulent mucus on the posterior wall representing drainage from the nasopharynx and paranasal sinuses above

In acute upper respiratory infection the lymph follicles on the posterior wall become hypertrophied just as do the tonsils and present red elevations several millimeters in diameter Occasionally and especially in young children acute streptococcic infection penetrates deeply and produces a *retropharyngeal abscess* similar to the peritonsillar abscess Inspection shows bulging and redness of the posterior pharyngeal wall and palpation with the tongue blade reveals tenderness Fluctuation or softening may be felt by the gloved finger if suppuration has taken place

The lymphoid tissue of the oropharynx is as favorite a spot for membrane formation in acute infections as are the tonsillar surfaces *Tuberculous ulcers* are found more often in the pharyngeal than the buccal mucosa A *gumma* may occur here also Lymphosarcoma acute lymphatic leukemia and agranulocytosis produce lesions identical with those described for the tonsil

The *pharyngeal* or *gag reflex* is absent in disease of the ninth and tenth cranial nerves though its absence in normal persons is not unusual

LARYNX

The routine examination usually does not include examination of the larynx and as a rule little would be gained by such an examination Nevertheless upon the development of hoarseness especially inspection is necessary either by mirror or by laryngoscope Thus inflammatory and neoplastic processes which may involve laryngeal

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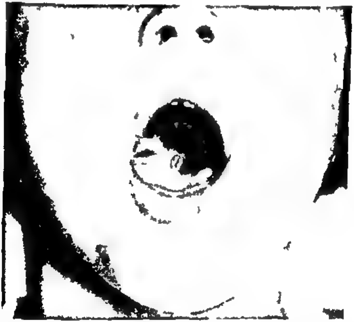

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structures, may be visualized Commonly, paralysis of the vocal cords means mediastinal disease, originating in the lymph nodes, aorta lung, or thyroid gland Frequently the left recurrent laryngeal nerve is injured at thyroidectomy, resulting in paralysis of the left vocal cord Much less commonly, *laryngeal paralysis* indicates central nervous system disease

THE BREATH

Under ordinary circumstances, the breath does not attract attention as the examiner is inspecting the buccal cavity or oropharynx

The odor of tobacco alcohol ether, garlic, and other substances excreted to some extent in the lungs, is readily recognized Unpleasant odors, even to a degree which might be called 'foul' may accompany poor dental hygiene and gingivitis, chronic sinusitis atrophic rhinitis, acute infections of the nasopharynx and oropharynx and ulcerating neoplasms Foul breath usually accompanies saccular bronchiectasis, lung abscess and pulmonary gangrene

The acetone breath of diabetic coma is easily recognized occasionally even upon entering the patient s room Similarly, the urinary odor in the uremic state is readily appreciated

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7. THE NECK—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

THOUGH AT FIRST thought the rather small mass of body tissue encompassed in this anatomic segment may seem not to warrant separate chapters the student soon will learn in clinical medicine that this is not true Not only does the neck contain many important structures but changes in these often give clues to disease distant from the neck especially within the chest

Inspection and *palpation* are the two major technics used in examination of the neck At times, *auscultation* is used with benefit

The main structures in the neck which are of particular interest to us are in addition to the muscles and skeletal structures the lymph nodes thyroid gland larynx trachea and various arteries and veins

The neck will be found to vary greatly in its general structure as it is related to the subject s constitution This variability modifies to some degree the extent and adequacy of the examination In the hyposthenic or asthenic person the neck is thin and long permitting easy access to anatomic structures by palpation At the opposite extreme is the extremely short thick, bull neck of the hypersthenic subject In such a neck it may be very difficult to examine the parts adequately especially if a heavy layer of subcutaneous fat is present

Inspection should be begun with the subject sitting in a relaxed condition hands lying in the lap, if on an examining table or in bed lying in the recumbent position he should lie straight and relaxed with the hands at his side or loosely crossed over the abdomen In applying both inspection and palpation the examiner should feel free to move the subject s head passively in order to vary tension of the muscles and position of the cervical spine so as to facilitate the ex

amination At the same time information is gleaned regarding the mobility of the cervical spine and function of the neck muscles

Inspection and Palpation

In examination of the cervical spine the patient actively upon instruction or the examiner passively moves the neck backward in extension forward in flexion and laterally in lateral flexion or in rotation The trapezius sternocleidomastoid and scalene muscles are palpated as well as observed in motion

Inspection Inspection other than that related to the musculoskeletal system has as its major function the detection of abnormalities causing *asymmetry* between the two sides Unusual tumefactions or swellings and pulsations must be noted Thus the technic of inspection consists of having the subject favorably placed as described above so that the muscles of both sides are equally relaxed Furthermore a good light must provide both sides with adequate lighting for comparison The examiner sits or stands in front of the subject and compares like areas

The areas at the angles of the mandible are compared Then the submandibular areas are inspected for fulness or swelling Next inspection takes stock of the anterior triangles of the neck anterior to the sternocleidomastoid muscles and of the lower portion of the suprasternal region Then the triangles below and posterior to the sternocleidomastoid muscles are compared the glance then finally sweeps the portions at the base of the neck and in the supraclavicular fossae comparing the two sides Throughout any degree of asymmetry must be noted for an analysis as to its cause (In the obese person fulness of the supraclavicular areas due to pads of fat is commonly seen Upon movements of the arms or neck these may be prominent and occasionally are thought by the lay person to represent tumors)

Palpation This begins with bilateral palpation of the region below the ear the fingers then dropping down over the posterior surface of the trapezius muscles Palpation next is directed to the posterior triangle to feel for possible enlargement of the lymph nodes of the posterior chain extending from the mastoid bone downward anterior

Fig 1 Simultaneous bilateral palpation for lymph nodes in posterior chains

Fig 2 Palpation for lymph nodes in anterior chain Head may be rotated passively to relax muscles thereby facilitating examination

to the trapezius muscle and outward and anteriorly to the clavicle noting any that may lie on the scalenus muscles (Fig 1) Any tumefactions in those regions are to be evaluated Both sides may be examined simultaneously or one side at a time the examiner placing his other hand on the subject s head so that it may be moved passively to provide muscular relaxation for freer palpation (Fig 2)

The next step in palpation is a similar exploration of the triangle anterior to the sternocleidomastoid muscle First the fingers are passed along beneath the mandibular rami to note palpable sub mandibular and submental lymph nodes and to explore for disease of the submaxillary and sublingual salivary glands The palpating fingers then search anterior to the sternocleidomastoid muscle for lymph nodes of the anterior chain Next the hyoid bone the larynx and the thyroid gland area are examined

Lymph Nodes

Some teachers feel and with sound argument that the description of the lymph nodes should be a part of the general survey

In my opinion from convenience in my own examining technic and from observation of medical students it seems best to include examination of the lymph nodes of all the usual anatomic sites at one point in the physical examination Since the neck is the first place where one may expect to find appreciable adenopathy this affords a convenient time for the description of technics for examination of nodes elsewhere

Some physicians and teachers leave the axillary nodes to the time of the chest examination and the inguinal nodes to the abdominal examination I find that students frequently become so engrossed in the examination of the chest that they forget the nodes and over look lymphadenopathy Furthermore I believe there is another good reason for surveying as much of the lymphatic system at one time as possible If lymphadenopathy is present it seems only logical that the enlarged nodes of the axilla for example should be compared with those found elsewhere

Therefore in examination of the lymph nodes of the neck it is my custom to digress for a moment and to inspect the axillas and the

epitrochlear areas of the inner side of the upper arm for visible lymph node enlargement and then to palpate for nodes in these areas With few exceptions, I also examine the lymph nodes of the inguinal regions next In the examination for axillary nodes, the hand of the examiner is laid against the chest wall with the fingers high in the

Fig 3 Palpation for axillary lymph nodes

axilla to palpate for nodes on the chest wall The subject s arm has been dropped and is supported by the examiner s other hand so that the pectoral muscles and the serratus magnus are relaxed and thus do not interfere with the fingers reaching high into the axilla (Fig 3) In palpation for an enlarged epitrochlear node on the right side the examiner should support the subject s forearm or elbow with the right hand so that the muscles of the upper arm are relaxed The left hand

then encircles the lower portion of the upper arm so that the second or third finger will be in place to feel for the node just above the internal condyle of the humerus In palpation for the left epitrochlear node the right hand is used (Fig 4) The inguinal nodes lie above and medial to Poupart s ligament in the groin Below this in Scarpa s triangle enlargement of the subinguinal and femoral nodes may be encountered

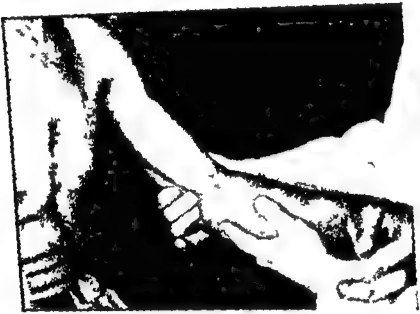

Fig 4 Palpation for epitrochlear lymph node

Theoretically a palpable lymph node is abnormal since only as the result of disease does it become enlarged Nevertheless no one passes infancy without developing a palpable node here and there and such nodes cannot be considered of pathologic significance and must be noted as within the normal or usual Thus most adults have had sufficient infection in the throat of the fingers and of the feet or toes to have palpable nodes at the respective sites of drainage

Certain observations should be made concerning every palpable lymph node It is upon these characteristics that much in the diagnosis of lymph node disease may depend Thus the following must be

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Fig 5 Fingers of the right hand are displacing the right lobe of a small colloid goiter (note fullness above suprasternal notch) with the larynx to the left for palpation by the fingers of the left hand.

ing at the thyroid region of one side pushes the larynx toward the opposite side where the palpating fingers of the other hand feel for the lobe or nodules on that side (Fig 5) Here again swallowing may be of aid since movement may bring out an enlarged lobe or nodules. The maneuver is then reversed to examine the opposite side Personally I prefer a second method to be used as follows The examiner

noted (1) color of the overlying skin, (2) tenderness, (3) size, (4) *consistency (soft fluctuant firm, or hard)*, (5) discreteness, (6) mobility (is the node movable over the underlying structures?), and (7) *attachment of the overlying skin to the node*

THYROID GLAND

In physical examinations, the student must think of the anatomic relationships of structures as learned in the dissecting room or at the autopsy table The isthmus of the gland lies across the trachea just below the cricoid cartilage, the superior poles of the lateral lobes lie above the level of the isthmus adjacent to the thyroid cartilage, while the lower portion of the lobes lies lateral to the upper tracheal cartilages

In general, it may be said that the thyroid normally is not visible *Nevertheless physiologic hypertrophy may occur, so that not only a* fulness of the isthmus region is visible in the suprasternal notch but *also a fulness between the larynx and the sternocleidomastoid muscle* from enlargement of the lateral lobes. This physiologic enlargement is seen *in some girls at puberty, it also may occur during pregnancy* Enlargement may be demonstrated by having the patient elevate the chin to put the trachea under tension and then having him *swallow*

Palpation for the thyroid gland may be difficult or almost impossible in the person with a very short neck in whom the cricoid cartilage may actually lie at the superior border of the manubrium However in the majority of persons, this is not true and unless the subject is obese the isthmus can usually be palpated as a band or slight fulness of moderate firmness just below the cricoid cartilage The index finger tip, with or without the third finger, is moved in this maneuver up and down on the surface of the trachea in the suprasternal notch If the observer cannot be sure of his palpation it may be well to have the subject swallow As the larynx moves up in the act the isthmus may be felt to glide beneath the finger tips

Palpation for the lateral lobes may be carried out by one of two methods The first is to have the examiner stand behind the seated subject who elevates his chin somewhat The thumbs of the ex aminer are placed on the nape the fingers then fall over the lateral lobes of the thyroid gland One of the hands of the examiner, press

In thyroid disease auscultation with the stethoscope may reveal abnormalities to be discussed later

LARYNX AND TRACHEA

Normally these structures lie in midline Examination by inspection and palpation should reveal their position and also their mobility upon swallowing In the first stage of deglutition the hyoid bone larynx and trachea move upward later to move downward

Fig 7 Technic for demonstration of tracheal tug

In examination for the *tracheal tug* which may have significance in intrathoracic disease and which will be discussed in Chapter 8 the following maneuver is carried out With the subject s chin slightly elevated to put the trachea under moderate tension the examiner places the tips of the thumb and index finger beneath the cricoid cartilage with slight pressure directed upward (Fig 7) If a tug is present a pull is exerted upon the finger tips with the cardiac systole At times the movement of the fingers may be easily seen The proper tension of the trachea is often essential and may be varied by asking the patient to elevate or depress the chin (Some observers prefer to

sits in front of the seated patient or stands beside the patient, who is lying on the examining table or in bed If by palpation one is searching for the right lobe, for example the fingers of the examiner s left hand are placed behind the sternocleidomastoid muscle at just above the level of the clavicle (Fig 6) These fingers act to prevent retrodisplacement of structures by the other hand Then the fingers of the right hand are passed between the sternocleidomastoid muscle at the level of the clavicle, the palmar surface of the fingers directed toward the larynx These palpating fingers are directed backward and downward, and in the act of swallowing the thyroid lobe or its contained nodules may be felt When palpating for the patient s left lobe the position of the hands is reversed

Fig 6 Technic for palpation of thyroid gland from the front

Usually, the lateral lobes are not palpable unless there has been former thyroid disease or unless there is disease at the moment In the physiologic enlargement of the thyroid gland at puberty in the female in some at the time of menstruation and during pregnancy lobes of moderate softness may be palpated

In searching for retrosternal extensions from the thyroid gland percussion of the infraclavicular area and of the manubrium is necessary The demonstration of the tracheal tone change to be described in the chapters on the chest (Chapters 10 and 11), is useful also in an attempt to show the presence of retrosternal thyroid enlargement X ray examination is also used for this purpose

8. THE NECK—2

FINDINGS IN DISEASE

SPINE AND MUSCLES

BY USING THE maneuvers described in Chapter 7 abnormalities of the spine and muscles may be demonstrated

The commonest disease of the cervical spine is *arthritis* In its most marked degree it causes the poker spine characterized by such fixation due to bony overgrowth that the patient cannot move the head in any direction nor can the examiner move the head passively In lesser grades of arthritis the movements of the neck may be limited in one or more directions This may be observed even as the person enters the doctor s office Such limited movement may be accom panied by pain and muscle spasm A grating sound due to fibrous changes in the periarticular tissues may be heard or felt on passive motion

In *ruptured nucleus pulposus* in *fracture of a cervical vertebra* in *subluxation of a vertebra* or in *tuberculous spondylitis* the spine will be fixed to movement by muscle spasm as well as by the result of the mechanical factors themselves

The congenital anomaly of *cervical rib* can be felt at times in the thin necked person if one palpates deeply directing the fingers posteriorly in the neck just in front of the trapezius muscle at about the level of the clavicle Passive rotation of the neck may assist in the examination

Reflex *muscle spasm* accompanies disease of the cervical spine as a protective splinting to reduce painful movement to a minimum Thus in any of the above mentioned diseases of the spine (exclusive of cervical rib), the trapezius and sternocleidomastoid muscles will

stand behind the seated patient, who elevates his chin, and then to place the tips of both index fingers beneath the cricoid cartilage)

BLOOD VESSELS

Note is made of the *superficial veins*, their fulness and whether pulsation is visible Inspection is the method of examination employed

In thin persons in the absence of cardiovascular disease, slight systolic pulsation may be seen at times at the base of the neck This usually originates in the common carotid artery Palpation may confirm this *In the elderly patient pulsation from the aortic arch* is seen not uncommonly in the suprasternal notch Less often it may be found in the thin person of younger years Though pulsation below the clavicle properly belongs in the chapter on examination of the heart inspection of the neck often attracts attention to such pulsation In the spare person and especially in one with a chest whose contour approaches the flat type it is not unusual to note systolic pulsation immediately below the clavicle in its lateral half and just medial to the fullness of the shoulder This originates in the axillary artery

The stethoscope may give aid in the evaluation of abnormal pulsations in the neck as will be brought out in Chapter 8 and in that on heart disease (Chapter 13)

be spastic either on one or on both sides If unilateral the examiner may note by inspection asymmetry or fulness in the region of the spastic muscle as compared to its fellow On palpation the affected muscle is firmer or more taut than its fellow, and even may be hard in consistency It is tender on pressure or percussion With marked

Fig 3 (Same patient as in Fig 2) Torticollis due to congenital band

spasm of a muscle the head may be pulled to one side or backward and be held in this position

The degree of muscle spasm which may develop as reflex protection is well demonstrated in acute meningitis where movements of the inflamed meninges are painful Here the muscles contract to such degree that the head may be pulled back into extreme extension the neck being so arched that the head rests on the occipitoparietal region This is diagnostic of meningitis or extreme meningeal irritation (Fig 31 page 83) Similarly if the examiner attempts to lift the patient's head from the pillow such muscle spasm may be induced that the

Fig 1 Congenital torticollis due to shortened sternocleidomastoid muscle

Fig 2 Characteristic posture of wryneck

Fı 4 Branchial cyst

Fig 5 Thyroglossal-duct cyst.

whole spinal column represents a rigid structure As a result, the whole body down to the hips is raised in this maneuver

The best example of spasm is so called "wryneck," or *torticollis* due to tonic spasm of one or other of the cervical muscles Not only does it develop because of spinal disease, but it also may accompany inflammatory disease of other cervical structures to be detailed below Wryneck may also occur apparently from intrinsic muscular involvement, probably of inflammatory nature since it is encountered at times in the course of acute upper respiratory disease *Congenital torticollis* is due to an anomalous shortening of a sternocleidomastoid muscle (Fig 1) At times there is muscle atrophy, with a firm band like replacement of fibrous tissue (Figs 2 3) *Clonic torticollis* may be present as a tic or habit spasm, the sternocleidomastoid muscle or trapezius contracting at intervals to pull the head to one side

Contraction of the sternocleidomastoid and scalene group of muscles bilaterally is seen in extreme dyspnea These are accessory muscles of respiration and by their contraction the upper ribs are elevated to increase the volume of the chest permitting a greater volume of tidal air

Muscle atrophy or wasting of the muscles of the neck occurs in several diseases of the central nervous system Anterior poliomyelitis may be a cause as well as certain diseases of the upper cervical segmental nerves and certain of the muscular dystrophies and atrophies

Soft Structures of Neck

Leaving the musculoskeletal system, examination of the soft structures of the neck is in order The routine of examination has been indicated in Chapter 7

In the region of the angle of the mandible one may encounter the prominent swelling of the parotid gland in *epidemic parotitis* (mumps) extending from in front of the ear downward and backward under the lobe of the ear (Fig 21 page 170) A similar but hard swelling occurs in *Mikulicz s disease* sarcoidosis and in tumors of the parotid gland Both in mumps and in Mikulicz s disease there may be swelling of the submaxillary and sublingual salivary glands with tumefaction, which is tender and firm in their respective regions Any

below the mandible may be lost and the swelling may be of such a grade as to destroy the normal contour

In the anterior triangle occurs the rare *branchial cyst* arising from an anlage of a branchial cleft it appears as a round firm and at times soft tumor which may be several centimeters in diameter (Fig 4) Rarely in the same area may be seen the round firm tumor

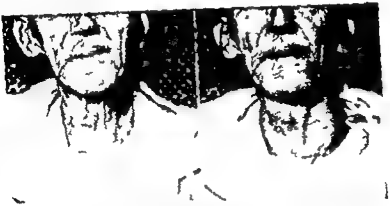

Fig 7 Diverticulum of upper portion of esophagus shown in empty state and on right filled after eating

arising from the *carotid body* at the level of the bifurcation of the common carotid artery In the midline anteriorly at any level from the thyroid isthmus to the base of the tongue in the line of the embryonal thyroglossal duct there may develop the firm round tumor of a *thyroglossal cyst* varying in size from 1 5 to 3 cm in diameter (Fig 5) Occasionally the thyroglossal duct is represented by a *sinus* opening on the surface of the neck (Fig 6) In addition to these rare tumors more common ones of varied origin may occur in any area such as lipomas fibromas and others These may originate from the soft tissue or from bone A soft tumor which appears with eating is due to *esophageal diverticulum* (Fig 7) *Lipomas* are not uncommonly found in the supraclavicular area or at the base of the neck (Fig 10)

Lymph Node Disease

Lymph node enlargement actually may be visible as such by casual inspection or may be suspected because of distortion of the contour

of the salivary glands may swell and become tense if obstruction develops as the result of a *salivary duct stone*

Actinomycosis originating commonly about one of the lower molar teeth, causes a brawny swelling over the mandible involving also the

Fig 6 Thyroglossal duct sinus

submaxillary regions The overlying skin is purple red in color and may present draining sinuses *Ludwig's angina* represents extensive suppurative infection of the neck tissues beginning often from a periodontal tonsillar or other infection It appears as a painful hard swelling of the floor of the mouth and submaxillary tissues extending downward into the neck to distort the normal contour of the triangle anterior to the sternocleidomastoid muscle The usual concavity

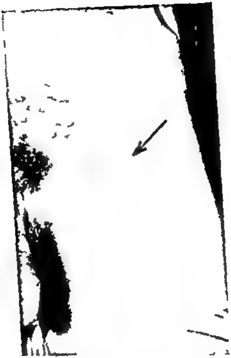

Fig 9 Adenitis of ubinguinal node in cat scratch disease

Fig 10 Tuberculous lymphadenitis (arrow indicates draining sinus inflamed skin is seen lateral to and above this site)

of the neck If the head is rotated to the side to the fullest degree, lymph nodes of the posterior cervical chain lying upon the trapezius muscle may become visible More commonly nodes are felt by the palpating fingers in the routine examination as described in Chapter 7 The characteristics of the several types of lymphadenopathy will be described

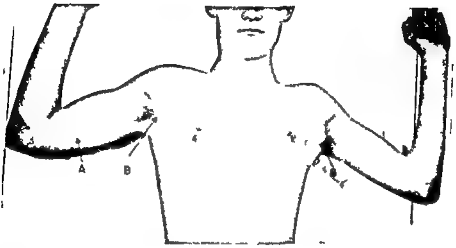

Fig 8 Lymphadenitis due to tularemia *A* Epitrochlear node *B* Axillary nodes

Acute Inflammation The most commonly encountered lymph adenitis accompanies infection about the mouth or throat and practically every reader has experienced this With tonsillitis or pharyngitis the node beneath the angle of the jaw is commonly enlarged It may reach 1 to 2 cm in diameter and be movable but tender and even painful Many persons have a small node palpable at this site as a residuum from recurrent bouts of acute lymphadenitis Such a node is firm and nontender between infections enlarging and becoming tender with each recurring sore throat With periodontal root abscess or canker sores, enlarged lymph nodes may develop farther forward or under the chin, depending upon the site of infection and the lymph drainage Chancre of the lip is accompanied by marked swelling of the node or nodes draining the affected area Such nodes are usually quite hard

In the presence of infection of the scalp enlargement of lymph nodes occurs at the occipital region, over the mastoid bone, over the

Systemic Infection In German measles (rubella) the lymph nodes of the posterior cervical chains especially are enlarged In the secondary stage of syphilis all nodes cervical axillary epitrochlear and inguinal are commonly enlarged Upon turning the patient s head to the side the nodes of the posterior chain may be seen easily

Fig 12 Hodgkin s disease manifest as collar of enlarged lymph nodes Enlargement of preauricular nodes is also visible

The lymphadenopathy which may accompany infectious mononucleosis is similar to that of syphilis In all these diseases the nodes may vary in size from a centimeter in diameter to oblong enlargements 1 by 2 to 3 cm in size Tenderness is not marked the nodes being freely movable and of only moderate firmness The generalized syphilitic adenitis leaves in some a small firm shotty adenopathy for the remainder of the patient s life

trapezius muscles, and in the posterior cervical chain Infection of the skin of the neck may be associated with enlargement of any of the cervical lymph nodes

Infection of fingers or hands may cause painful, tender, firm lymph adenopathy of the epitrochlear and especially the axillary nodes (Fig 8) Infection of the breast may cause similar effects in the axillary nodes If infection occurs of the toes feet, or legs, or the external genitalia, similar lymphadenopathy develops in the femoral and/or

Fig 11 Scars of former draining sinuses due to tuberculous lymphadenitis (incidental lipoma of supraclavicular fossa is visible)

inguinal nodes, depending upon the lymphatic drainage (*Fig 9*) The matted lymph nodes in lymphopathia venereum are characterized by little mobility and a purple red color of the overlying skin Healing leaves an adherent scar (Fig 9 page 597)

In any lymphadenitis due to pyogenic organisms the inflammation of the lymph node may go on to *suppuration* there being softening of the node, redness, adherence of the overlying skin and finally rupture of pus through the skin

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sually of unknown nature or origin The antigen in serum sickness nay be definite In sarcoidosis the collagen diseases and in atypical heumatoid arthritis (Felty s Syndrome) the etiology of the lymph adenopathy is not clear

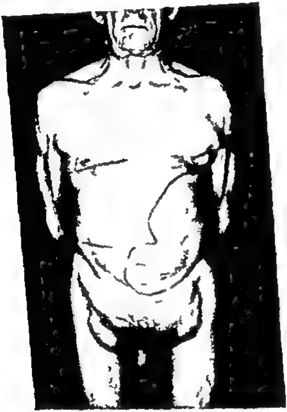

Fig 14 Lymphatic leukemia Enlargement of cervical axillary inguinal and femoral nodes with obstructive edema of genitalia hepatomegaly and splenomegaly as outlined

Lymphoblastoma *Hodgkin s disease* is characterized by enlargement of lymph nodes from those of 1 cm in diameter to matted masses of nodes as big as a fist The involvement may be generalized at once or may be localized to one group of nodes for months before the disease becomes more general in distribution The nodes are slightly if at all tender are of a rubbery consistency and remain movable for a long time Later they may become matted in large

Tuberculosis This form of lymphadenitis common in past years is limited usually to the tonsillar node or nodes, infection occurring as a result of ingested organisms lodging in the tonsillar area and thus reaching the nodes The lymph nodes enlarge, become matted together, and become fixed to the underlying tissue and the overlying

Fig 13 Lymphatic leukemia Enlargement of axillary and pectoral nodes leukemia cutis of abdominal wall subcutaneous and cutaneous nodules of forehead

skin, the latter being purplish red in color (so called cold inflammation') Usually softening and drainage with sinus formation develop (Fig 10) Finally upon healing ragged often multiple adherent fixed scars remain leaving a label for life that *scrofula* has been there (Fig 11)

Tissue Sensitivity Generalized lymphadenopathy may accompany diseases that may represent sensitivity of tissues to some antigen

hard is tender and painful and becomes fixed to the underlying tissue The overlying skin often becomes attached to the mass In the neck the primary source of metastasis may be carcinoma of the naso pharynx tonsil tongue or lip the node or nodes draining the area being involved Thus in carcinoma of the lip the submental nodes

Fig 16 Local metastasis from carcinoma of thyroid gland Infra red photograph shows obstruction to venous return flow

are affected first and early In malignancy of the tonsil or nasopharynx the node beneath the mandible is affected (Fig 15) Carcinoma of the thyroid gland may metastasize to the nodes of the anterior cervical chain and to the supraclavicular nodes (Fig 16) The same is true of malignant tumors of the larynx Cancer of the bronchus not un commonly may metastasize to the supraclavicular nodes of the af fected side Carcinoma of the stomach occasionally may involve the

masses Commonly, the overlying skin does not become adherent to the enlarged nodes The masses may become fixed to underlying or surrounding tissues because the process invades the capsule of the lymph node Suppuration with drainage never occurs (Fig 12) *Lymphosarcoma* develops in one node or in a group of nodes as a rapidly enlarging, tender mass at any one of the usual sites of lymph adenopathy Lymphoblastomatous involvement of mediastinal nodes will be discussed elsewhere (page 398), the suspected disease being demonstrated by the use of the x ray in diagnosis

Fig 15 Metastases to cervical lymph nodes in carcinoma of nasopharynx

Leukemia Generalized lymphadenopathy of variable size is characteristic of lymphatic leukemia and also occurs rarely in some cases of myelogenous leukemia The nodes usually remain discrete and movable (Figs 13 14)

Metastatic Malignancy Carcinoma is the most common malig nant tumor to metastasize to lymph nodes draining the involved area Obviously, this may occur anywhere in the body Here we are interested only in the superficial nodes At first the carcinomatous node is small discrete and movable With time it may enlarge to a mass from several to 6 or 8 cm in diameter The node becomes stony

supraclavicular lymph node on the left side at the base of the neck (Virchow s node) Draining lymph channels along the thoracic duct account for this route of metastasis In the axilla one may encounter not uncommonly metastasis from cancer of the breast other metastatic nodes may be felt along the inferior margin of the pectoralis major muscle The inguinal nodes may be the site of metastasis from malig nant disease of the vulva the penis and testicles

Thyroid Gland

In addition to the physiologic thyroid enlargement considered under the normal variations described in Chapter 7 diseases of the

Fig 19 Toxic nodular goiter

thyroid offer interesting physical changes which are of great impor tance

The *simple or colloid goiter* as found endemically in iodine poor areas of the world is an enlargement due to colloid accumulation (Figs 17 18) It appears as a diffuse generalized enlargement of the lobes and isthmus and is easily visible On palpation it varies from

Fig 17 Diffuse colloid goiter of moderate size

Fig 18 Large colloid goiter

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the superior thyroid artery may reveal a thrill or palpable vibration The stethoscope applied at this point picks this up as a swishing sound or bruit This hyperplastic gland is associated with the silky skin tremor of the lips tongue and fingers thyroid facies and eye signs described on page 185 In addition there are cardiovascular signs of interest to be discussed later (Chapter 13)

Finally, there is the *nodular thyroid* in which nodules of 1 cm or more in diameter may be palpated in either or both lobes or in the isthmus These nodules are commonly met with and may develop in the colloid goiter as noted above They may be true fetal adenomas or much more commonly local hyperplastic areas in the gland (Fig 19) The nodules are firm and the gland is movable in the conditions just mentioned Hard nodules should suggest *carcinoma* Such a process soon breaks through the capsule so that the gland becomes fixed to the surrounding tissue (Fig 20) Adjacent hard lymph nodes are significant as evidence of metastasis (Parathyroid adenomas cannot be differentiated from nodules in the thyroid gland Large thyroid nodules may displace the larynx or trachea

Enlargement of the lower portion of a lobe may extend downward retrosternally its presence being suggested if tracheal deviation occurs Percussion may reveal impairment of the note over the manubrium or lateral to it in the first interspace This point will be dealt with in more detail later as will the change in tracheal tone (see page 381)

An exquisitely tender goiter and painful deglutition suggest *thyroiditis*

LARYNX AND TRACHEA

The larynx and trachea may be displaced by tumors masses of enlarged lymph nodes and enlargement of the thyroid nodular or otherwise These are usually quite obvious Some of these conditions by pressure may produce atrophy of the cartilaginous rings of the trachea the so called scabbard trachea Disease in the upper mediastinum may do the same

Of greater diagnostic importance is *deviation* of the trachea in intrathoracic disease as will be more fully shown in succeeding chapters The observation of such an abnormality of the trachea may be a key diagnostic point at times In accumulations of a large

a soft to a hard gland Later, it may become nodular owing to hemorrhage, dilated acini, or cyst formation *Soft or moderately firm* localized irregularities may become visible or palpable Occasionally calcification of such areas leads to stony hard nodules from 1 5 to 3 cm in diameter The firm nodules of *hyperplasia* will be described

Fig 20 Carcinoma of thyroid gland

below The colloid goiter moves with deglutition Because of asymmetrical enlargement, it may compress the trachea and deviate it and the larynx from the midline

In *thyrotoxicosis* (Graves disease) the diffusely enlarged thyroid gland is usually visible and is almost always palpable It is felt to be of a fleshy consistency and movable (*Fig 18 page 168*) Because of the increased vascularity light palpation over the site of entry of

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amount of fluid or of air in a pleural cavity the mediastinum and with it the trachea, will be pushed toward the opposite side In obstruction of a bronchus and/or collapse of a lung the mediastinal contents, and with these the trachea, will be displaced to the side of disease Fibroid disease in a lung commonly pulls the trachea to the side of the lesion Diseases of the great vessels of the upper mediastinum may affect the position of the trachea tremendously

The production of the *tracheal tug* described in Chapter 7 is *caused by disease involving the left major bronchus and the aortic* arch as it passes over it Most frequently, the tug is due to an aneurysmal sac of the descending arch of the aorta pressing downward on the bronchus with each systolic expansion of the sac the downward pull being reflected in a tug on the trachea I have seen carcinoma of the left bronchus, involving the aortic arch in the malignant mass, give this finding Commonly, hoarseness due to *laryngeal paralysis* accompanies tracheal tug because the recurrent laryngeal nerve is apt to be involved in the disease process as the result of its location

In discussion of diseases of the trachea, a few words may be said relative to *retraction* or a pulling in, of the supraclavicular area and especially of the suprasternal notch region in the serious air hunger of obstruction in the respiratory tree With the intense inspiratory effort the intrathoracic negative pressure is increased resulting in this inward movement It is observed at its best in the young who have aspirated a foreign body and whose soft tissues and elastic chest show the inspiratory retraction in a dramatic and diagnostic fashion

As was noted in Chapter 7, the larynx and trachea should move with swallowing They may be so fixed by inflammatory or malignant disease that movement is impossible

Blood Vessels

The significance of venous distention and pulsation can be considered best in the chapter on cardiovascular disease (Chapter 13) Collateral venous circulation logically is related to diseases of the mediastinum

The visible, quick pulsation of the carotid artery is suggestive of

free aortic regurgitation Pulsation in the right supraclavicular fossa may be due to aneurysm of the innominate artery or of the aortic arch (Fig 21) The latter may account for similar pulsation on the left

A visible or palpable expansile tumor of the carotid artery means aneurysm To the unwary or to the novice the serpentine calcified

Fig 71 Fullness above clavicle (indicated by arrow) as result of aneurysm of innominate artery Distended veins in erect position are indicative of obstruction

carotid artery in the aged projecting as a loop anteriorly between the sternocleidomastoid muscle and larynx may be mistaken for a carotid artery aneurysm The differentiation depends upon the demonstration of expansibility by grasping the suspected aneurysm between two fingers If expansion is present there will be a separation of the fingers at systole

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9. THE BREAST

EXAMINATION OF THE NORMAL

THE PROPER EXAMINATION of the breast is essential as part of the routine examination especially in every female after the age of thirty This fact is becoming known even to the layman as the result of the publicity given to this matter in the so called cancer weeks Though as will appear later numerous other diseases do occur in the breast it is carcinoma which has focused attention upon the breast This is as it should be In the female cancer of the breast accounts for a high percentage of all malignancies by its anatomic location it presents a form of neoplasm amenable to satisfactory treatment if the diagnosis is made early

In examination of the breast only two of the main methods are employed namely inspection and palpation The former is all too often neglected for the latter Examination must be carried out with both breasts uncovered for comparison Furthermore they must be examined both in the recumbent and in the sitting position

Inspection This must be carried out with the help of good lighting so that even slight irregularities in contour may be noted Upon inspection the observer will note the position of the breasts and of the nipples Symmetry should be looked for both as to position and as to size Observations must include a comparison of the nipples their pigmentation and of the skin of the two breasts (Upon palpation further information may be obtained with regard to changes in the skin of the nipple or to masses within the breast tissue)

Position In the young spare male the nipple with its surrounding areola will be found to be over the fourth intercostal space approximately in the midclavicular line The thin flat chested woman will show the same anatomic placement of the nipple In these types both male and female the nipple may be used as an anatomic land

In the suprasternal notch there may be both visible or palpable pulsation resulting from elongation or dilatation of the aorta A thrill may be felt at times These abnormalities will be discussed in more detail in the chapter on heart disease (Chapter 13)

The discussion of diseases of the chest (Chapter 11) will include subcutaneous emphysema Air may extend to the subcutaneous tissues of the neck and be obvious there also

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result of the recurrent hypertrophy of lactation and subsequent reces sion the breasts sag the nipple especially dropping lower and lower (Fig 1) Thus breasts whose nipple may hang as low as the level of the umbilicus cannot be said to be abnormal Also with atrophy of the breast tissue with age the breasts tend to sag this process often begins at about the time of the menopause It should be realized that

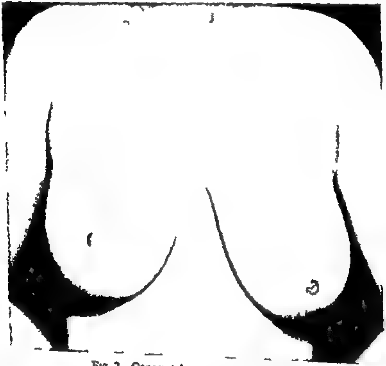

Fig 2 Congenital asymmetry of breasts

in the pendulous breast the glandular or true breast tissue is at the lowest portion with the nipple The remainder of the breast is merely a pedicle of fat and connective tissue septums Usually the breasts hang symmetrically at the same level Occasionally even under nor mal circumstances the one is a bit lower than the other (Fig 2)

Size The breasts first begin to enlarge at puberty At the time of the menses the breasts appear enlarged and engorged in some persons Enlargement of the breasts is progressive during pregnancy and main tained during lactation

mark, and the *mammary line* is used for descriptive purposes by some (it is essentially the same as the midclavicular line)

With the accumulation of fat even in the male, this usual anatomic relationship may be lost owing to some sagging of the nipple below

Fig 1 Pendulous breasts

the fourth interspace This is accentuated in the old with the loss of skin elasticity even if there is not much fat

In most women the breasts containing a variable amount of fat shift so much with changes of position that the nipple cannot be used as a landmark The breast in the female usually may be said to extend in area from the third to the sixth ribs Even though a moderate amount of fat in the breast elevates it above the chest level it usually still occupies this anatomic position However with obesity or as the

more is learned by using the palmar aspect of the second to the fourth fingers which should be held in apposition or by the palm of the hand especially in the region of the carpophalangeal joints In either case the breast is palpated by a rotating motion moderate pressure being applied so as to feel for unusual irregularities in the tissue In applying such a method of palpation the breast tissue is pressed

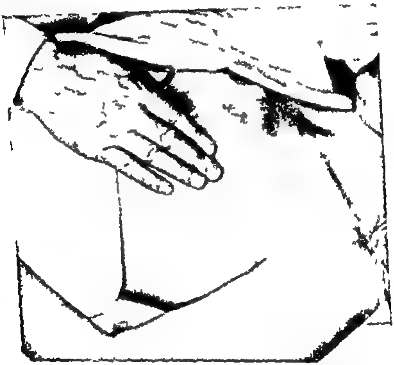

Fig 4 Technic of palpation Pressure of fingers fans out breast tissue to aid in recognition of nodules

against the chest wall in order to flatten it out As this is done the ducts are fanned out thereby making the palpation of small nodules or irregularities more probable (Fig 4)

The normal breast as in the palpation of fat anywhere offers a kind of irregular or granular sensation to the palpating fingers or hand However following lactation and after the menopause a diffuse nodularity is commonly present This results from tortuosity of the

Nipples The nipples usually are everted but may be inverted in some instances (Fig 6) The degree of pigmentation varies in the normal with the degree of general pigmentation, being darker in the *brunette* than in the blonde With pregnancy, pigmentation is intensified

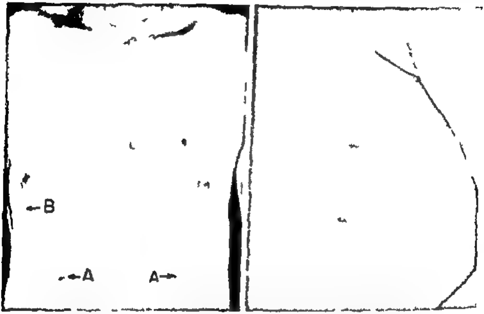

Fig 3 Supernumerary and rudimentary nipples On the left a man showing at A rudimentary nipples in the milkridge Many cherry angiomas as at B stud of the trunk On the right supernumerary nipple at lower border of left breast of a woman

An interesting atavistic anomaly is the *supernumerary nipple* (Fig 3) This may occur in either sex At times only a second nipple appears on one side more often on both sides making a total of four The accessory nipples appear in the mammary line below the *normal breast The author has seen three on a side* Rarely breast tissue is present under the supernumerary nipple, lactation occurs as an extreme rarity

Veins are often rather prominent over the breasts but especially so during lactation

Technic of Palpation Palpation of the breast is carried out with the fingers and palm of the hand Not much information is gained by bimanual palpation or by picking up the breast between the fingers since a tumor may be lost in the mass of ducts and other tissue Much

FINDINGS IN DISEASE

Endocrine Disease In either sex breast changes may occur along with changes in the secondary sex characterisics in diseases of the endocrine system involving the pituitary adrenal, and/or sex hormones Thus in the male the breasts may take on a feminine configuration at the same time that the beard is lost or becomes sparse and the pubic hair assumes a feminine distribution (Fig 19 page 74) By contrast in the female the breasts may atrophy while the facial and body hair increases

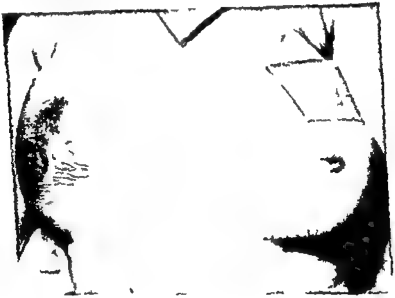

Fig 6 Acute mastitis with abscess format on in right breast (nipple is inverted in unaffected breast)

Abnormalities of the breast may occur due to endocrinologic influences even though the endocrine glands themselves are unaffected Such an example encountered at times is the *gynecomastia* which may develop when there is severe damage to the liver notably in portal cirrhosis Under such circumstances the feminization of the male breast is probably due to hyperestrinemia as the result of the liver s inability to inactivate circulating estrogen This abnormality also has been described in instances of infectious hepatitis

ducts, which remains following the regression of the hyperplasia occurring normally in lactation and with the menses Since the nipple contains erectile tissue it should become erect upon the manipulation of the breast as described above

Fig 5 Mastitis in male breast

Tenderness should not be present in the normal breast except at the time of its growth at puberty or that associated with the engorgement at the time of the menses or during pregnancy

At times, islands of *aberrant breast* tissue appear lateral to the breast toward the axilla The subject is aware of tenderness in such areas at the time of the menses With the hypertrophy which occurs during pregnancy, a tumor may appear at such a site the tumor is tender and may reach a size several centimeters in diameter

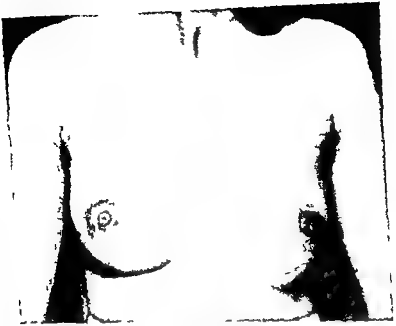

Fig 8 Fulness of right breast due to chronic cystic mastitis (blue dome cyst)

Fig 9 Adenofibroma (tumor is seen as prominence above areola of left breast)

Position The position of the breasts may be asymmetrical One breast may be lower than the other as the result of spinal scoliosis or of chest disease either of which may lead to chest deformity

Inflammations Inflammatory reactions may occur in either sex though rarely in the male As the result of trauma, there may be redness, tenderness, and swelling *Mastitis* may accompany mumps (These factors or metastatic infection offer the only occasion for inflammation in the male [Fig 5])

Fig 7 Syphilitic chancre of breast (Kampmeier R H Essentials of Syphilology J B Lippincott Co)

The female is subject to an inflammatory reaction much more often than the male The most common inflammatory disease is the *acute mastitis* which appears after childbirth or early in lactation Fever is often present Upon inspection the breasts present redness and swelling Palpation of the breast reveals tightness heat and tenderness (This is the so called caked breast) In some the inflammatory area breaks down and will be felt to be fluctuant, having changed to a *breast abscess* (Fig 6)

nodes will be present in the axilla of the affected side The rare gumma appears as a tumefaction which as it enlarges and approaches the skin appears much like the tuberculous lesion Palpation early demonstrates a tumor which later softens to be followed by chronic ulceration

Fig 11 Carcinoma Fixation retraction and pigmentation of skin overlying tumor just above nipple

Tumors of Breast By far the most important diseases of the breast fall into this category In searching for a tumor there are several features to be looked for and to be described They are the following

1 Asymmetry of the two breasts
2 Elevation or retraction of the skin (This may be brought out by displac

Tuberculosis of the breast is a rare chronic inflammation most often secondary to tuberculous involvement of an underlying rib In its presence, irregularity and swelling will be visible Later as the inflammation approaches the skin it appears bluish red Eventually the infectious process breaks through with residual draining sinuses

Fig 10 Carcinoma Tumor with fixation of overlying skin

Palpation reveals a hard infiltrative mass which leads to immobility of the breast and its attachment to underlying structures (These circumstances may make it most difficult to distinguish it from carcinoma)

Syphilis In the rare acute involvement as a chancre this infection is manifested as an ulcer 1 to 2 cm in diameter (Fig 7) It will be felt to be firm and nontender One or more enlarged tender lymph

in the tissue though firm they are more elastic in palpatory sensation They are attached neither to the overlying skin nor to the underlying chest wall Though chronic cystic mastitis may have some associated tenderness this is not true of the solitary benign tumors Malignant tumors are fixed in the breast tissue cannot be so readily demarcated

Fig 12 Carcinoma Retraction of nipple skin shows pigskin or orange peel characteristics

because of lack of mobility and give an impression of inelastic hard ness upon palpation Carcinoma except in very early stages is likely to show some attachment to the subcutaneous tissues as may be demonstrated in displacement of the breast and later will be attached to the chest wall *

* Cancer of the male breast occurs at times appearing at the nipple area and soon involving the skin and deeper structures

ing the breast in various directions, the fixation of the skin to underlying tissue may thus become evident As indicated on page 269 such observations must be carried out in a good light and in both the upright and recumbent positions)

3 Retraction of the nipple in either breast

4 Changes in the pigmentation of the areolas nipples or skin

5 The presence or absence of a palpable tumor in the breast

6 The mobility or fixation of the tumor if one is found

7 Attachment or fixation of the tumor to the skin as demonstrated by the maneuver described under item 2

8 Attachment or fixation of the tumor to the underlying chest wall

The above outlined points should be of assistance in differentiating between benign and malignant tumors

Of benign lesions *chronic cystic mastitis* is the most frequent usually found upon palpation (Fig 8) The breasts are diffusely nodular as the result of dilatation of the milk ducts Solitary benign tumors may be *lipomas* or *adenofibromas* (Fig 9)

The commonest malignant tumor of the breast is *carcinoma* The rare *sarcoma* of the breast is indistinguishable from carcinoma upon examination Its rapid growth and early ulceration suggest the diag nosis of sarcoma

The significance of the several features listed above will become apparent as applied to the differentiation of benign from malignant tumors of the breast

Asymmetry of the breasts may be apparent due to the presence of a tumor in one A benign tumor will not be attached to the skin In malignancy, the skin in its deeper layers may be fixed to the tumor and may be brought out as an obvious localized retraction or one made evident upon displacing the breast (Figs 10 11)

Retraction of the nipple will occur in the presence of carcinoma if the ducts beneath the nipple are involved The nipple then is not *erectile on stimulation* *Pigmentation or increased pigmentation* (if of the areola or nipple) may occur in the skin attached to an under lying malignant process The pores in the adherent skin may become prominent (Fig 12) These changes in the nipple or pigmentation of the skin will not be encountered in the presence of benign processes

If a tumor is found upon palpation, differential diagnosis may be aided by the following comparisons Benign tumors will be movable

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The significance of *axillary lymphadenopathy* has been discussed in Chapter 8 Palpation for nodes along the inferior border of the pectoral muscles and in the axilla must be part of the examination of the breast for tumor

Ulceration of malignant tumors usually represents a late stage in the disease

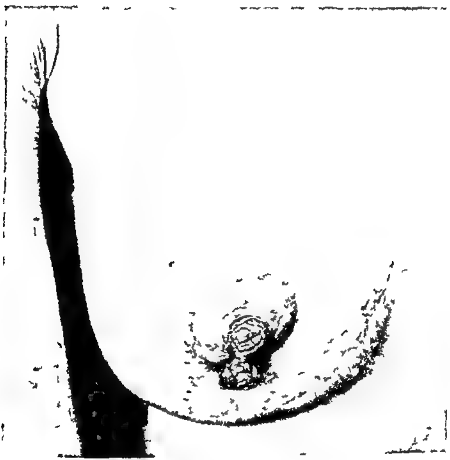

Fig 13 Papilloma of nipple

Tumors of Nipple *Paget s Disease* Carcinoma of the nipple should be thought of if inspection reveals a chronic crusted lesion of the nipple Upon removal of the crust a raw bleeding surface usually remains

Benign Tumors Benign tumors such as a papilloma may be seen occasionally (Fig 13)

that of tuberculosis Again the physical examination may be equally certain and after a few minutes spent upon examination of the sputum produced during the chest examination the physician may have made a more incontrovertible diagnosis than has the roentgenologist In such an instance the film is important in determining the limits of the disease process

If for no other reason than ease of application a fundamental knowledge of chest examination is essential To the student house officer or physician whose whole professional rearing has been within a few steps of the hospital x ray department it seems almost inconceivable that one may be forced to do much without its aid More patients are cared for in the home than in the hospital The patient with pneumonia cannot with ease be transported to a hospital for an x ray examination even if it is only several city blocks away leaving out of consideration the patient who lives twenty or thirty miles from the nearest hospital

These several paragraphs are not an apology for becoming well grounded in physical examination of the chest but are an answer to the question which I have heard students raise year after year Why examine the chest when the x ray examination gives so much more accurate information? House officers in their inexperience abet this attitude by leaning heavily on the roentgenologist s report *The author merely wishes to emphasize again that the physician first must know his patient both from the viewpoint of history and physical findings Then he must interpret the findings of those most valuable adjuncts to diagnosis the clinical laboratory roentgenology and electrocardiography*

The examination of the chest uses to the fullest the four routine methods of examination all of which have not been applied consistently in the patient study so far Inspection palpation percussion and auscultation have their application in varying degrees in study of the chest In the absence of disease palpation offers little in the examination nevertheless the student must know the palpatory findings in the normal condition in order to apply this technic critically when it may give information For the routine examination these four methods are applied in the order given since their correlation in this order seems to offer the best opportunity of arriving at an analysis

10. THE CHEST—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

MUCH OF THAT which has been emphasized during the first two or three decades of this century in examination of the chest has become obsolete or at least of much less importance. This change in some aspects of chest examination is due in the main to the application of the x ray examination to diagnosis and improvement in its technic in the past fifteen to twenty years. The x ray examination, which has been available mainly to the urban population, is becoming accessible more and more to those living in the rural and less populated areas. This is occurring through government subsidy of rural hospitals and county health departments, mobile x ray units, and possibly through a wider distribution of well trained radiologists.

Nevertheless, the author cannot subscribe to the attitude of some of the younger medical men who maintain that physical examination of the chest should be relegated to the limbo of the past. Every clinician has had the experience over and over of having the expert roentgenologist ask him regarding physical signs in a given case in order that he may interpret shadows in the chest film. The latter may indicate by shadows changes in the parenchyma of the lung, but the final diagnosis often depends upon a correlation of the history, the physical findings, and the results of the x ray examination.

Often the x ray examination alone can make the diagnosis, but it should not be forgotten that, just as often, physical examination can make the diagnosis equally as well. Thus the x ray film may show the characteristic shadow of lobar pneumonia, but the fingers and the stethoscope of the experienced clinician can make the diagnosis with equal facility. The chest film may show a cavity which is likely to be

areas of the neck they must often be used in the description of disease or abnormalities of the thoracic organs

Front of Chest The front of the chest is divided into the infra clavicular mammary and hypochondriac areas as shown in Fig 1

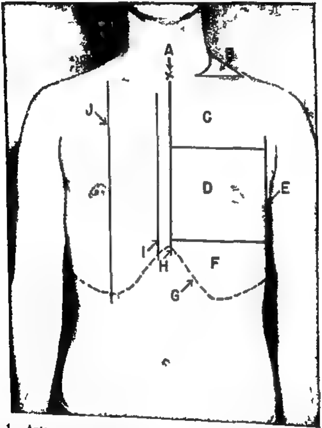

Fig 1 Anterior view of chest Landmarks—areas and lines *A* Supra sternal notch *B* Supraclavicular fossa *C* Infraclavicular area *D* Mammary area *E* Anterior axillary line *F* Hypochondriac area *G* Costal margin *H* Midsternal line *I* Sternal line *J* Midclavicular line

The *infraclavicular area* is bounded above by the clavicle medially by the midsternal line inferiorly by the lower border of the third rib and laterally by the anterior axillary line The *mammary area* is bounded above by the lower border of the third rib medially by the midsternal

of changes demonstrated in the thoracic organs The author would again like to emphasize that the student should apply what he has learned in the dissecting room at the autopsy table, in the pathology museum and in the physiology laboratory He should constantly try to visualize which changes in the lung for example will cause the abnormal physical findings in a given case

LANDMARKS

Just as the geographer must have ways and means to describe the position of physiographic features by latitude and longitude, so must the physician have methods of describing the location of findings upon examination He therefore uses anatomic landmarks on the body as well as theoretic lines

Bony Landmarks The bony landmarks are the clavicle the several portions of the sternum and the individual ribs, costal cartilages and their respective interspaces The student will find the second rib the easiest from which to count As he will recall this is the one which lies at the level of the junction of the first and second portions of the sternum (angle of Louis) The respective intercostal space or interspace is that immediately beneath the rib Thus the second interspace is below the second rib Posteriorly the bony landmarks are the spinous processes, readily numbered from the prominent seventh cervical, spinous process The spine of the scapula, the angle of the scapula and the acromial process also are bony landmarks (The nipple in thin males is a satisfactory landmark, but in the obese and in females it is too variable)

Anatomic Areas Certain anatomic areas, both those sharply bounded by anatomic structures and those bounded by theoretic lines are used in describing findings

The suprasternal notch the area above the sternum and bounded by the lower part of the bellies of the sternocleidomastoid muscles is really in the neck The supraclavicular fossae are spaces, or areas also related to the neck (Fig 1) Anteriorly this area is bounded by the clavicle, posteriorly by the superior border of the trapezius muscle, and medially by a line drawn from the sternoclavicular joint posteriorly to meet the trapezius muscle Though both of these are

anterior axillary fold (*anterior axillary line*) and from the posterior axillary fold (*posterior axillary line*) when the arm is held horizontally A line dropped from the apex of the axilla is spoken of as the midaxillary line Below the sixth rib and within the anterior

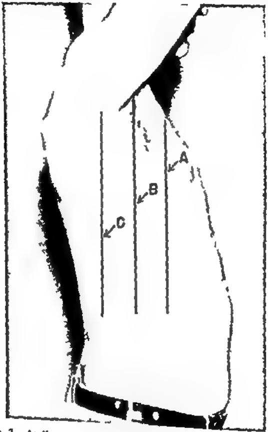

Fig 3 Axilla *A* Anterior axillary line *B* Midaxillary line *C* Posterior axillary line

and posterior axillary lines the area extending to below the twelfth rib is spoken of as the *infra-axillary area* (Figs 2 3)

Posterior Areas Posteriorly several areas are used for descriptive purposes The *suprascapular areas* are essentially triangular bounded above and laterally by the superior border of the trapezius muscle medially by the interscapular area and below by the scapular spine

line, below by the lower border of the sixth rib, and laterally by the *anterior axillary line* The *hypochondriac area* is essentially triangular being bounded above by the lower border of the sixth rib laterally by the anterior axillary line, and below and medially by the upswing of

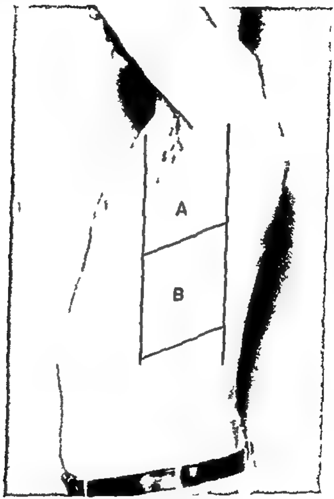

Fig ■ Axilla *A* Axillary area *B* Infra axillary area

the lower border of the tenth rib and the costal cartilages to join the sternum Actually this is an abdominal area covering little pulmonary tissue (see Chapter 14)

Axilla The axilla, or axillary area includes within its boundaries the lateral aspect of the chest down to the lower border of the sixth rib It is bounded by theoretic lines dropped vertically from the

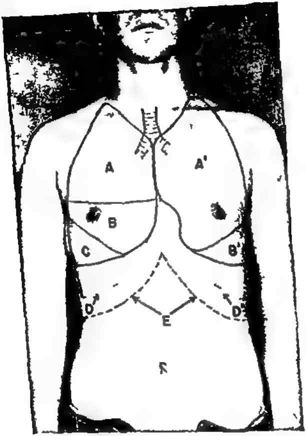

Fig 5 Topographic anatomy of lungs and pleurae as viewed from front A Right upper lobe A^1 Left upper lobe B Right middle lobe C Right lower lobe B^1 Left lower lobe D Pleural reflection on right. D^1 Pleural reflection on left. E Costal margins

used commonly as a point of origin for cardiac measurements At the border of the sternum is the *sternal line* Dropped vertically from the midpoint of the clavicle is the *midclavicular line* * usually going through the nipple in the spare male (Fig 1) (Under such circumstances the *mammary line* may be referred to In the obese or in the female this shifts too much to be useful as a landmark) Halfway between this line and the sternal line is the *parasternal line* which the

* By common usage and for the sake of brevity MSL and MCL are abbreviations useful in the recording of physical finding for midsternal and midclavicular lines respectively

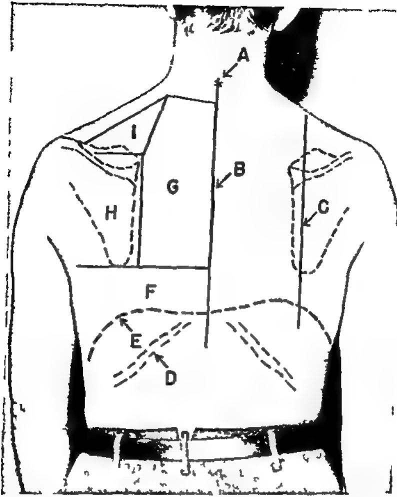

Fig 4 Posterior view of chest Landmarks—areas and lines *A* Seventh cervical vertebra *B* Vertebral line *C* Scapular line *D* Tenth rib *E* Dome of diaphragm *F* Infrascapular area *G* Interscapular area *H* Scapular area *I* Suprascapular area

The *scapular region* is bounded above by the spine of the scapula medially by the vertebral border of the scapula, laterally by the posterior axillary line and below by the seventh rib (the level of the angle of scapula) The *interscapular space* (left and right) is the area enclosed by the vertebral borders of both scapulas and by the second rib above and the seventh below By the *infrascapular region* one denotes the area bounded above by the seventh rib medially by the spinal line below by the twelfth rib, and laterally by the posterior *axillary line* (*Fig* 4)

Lines In addition to the axillary lines described on page 289, several others are used for mapping purposes The *midsternal line* is

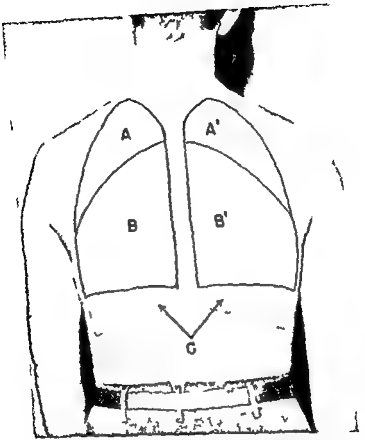

Fig 7 Topographic anatomy of lungs and pleurae as viewed from back *A* Left upper lobe *A*[1] Right upper lobe *B* Left lower lobe *B*[1] Right lower lobe *C* Pleural reflections

Topographic Anatomy of Pulmonary Lobes The student should have in mind during examination of the chest the approximate position of the interlobar sulci as projected upon the surface of the thorax This will be of assistance in the evaluation of signs and in the diagnosis of disease (Fig 5–12) *

The topography anatomy of the lobes and interlobar sulci as given is at best only an approximation Body type age development posture and point in the respiratory cycle all influence the anatomic relationships

The photographs and x ray films reproduced in this section were made in each instance of the same subject Thus the student may visually project the findings by use of the x ray examination upon the same subject's body surface

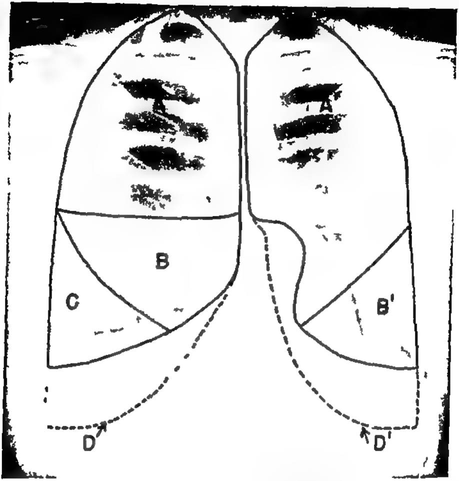

Fig 6 (Same subject as in Fig 5) Topographic anatomy of lungs and pleurae on x ray film as viewed from front

author believes is superfluous Posteriorly the *spinal line* marks the spinous processes in midline The *scapular lines* pass vertically through the angles of the scapulas (Fig 4)

Use of Areas and Lines The anatomic areas and theoretic lines which have been described are used to locate for the record and discussion normal or abnormal findings in the examination of the chest Thus rales may be described as being heard in the supra clavicular or suprascapular spaces cavernous breathing may be infra clavicular in location there may be dulness in the upper axilla the apex impulse of the heart may be in the midclavicular line in the fifth interspace or the left cardiac border may be in the midaxillary line

On the left side the interlobar sulcus begins posteriorly at the fourth dorsal vertebra (approximately at the level of the spine of the scapula) It then swings down laterally to cross the midaxillary line at about the fifth intercostal space reaching the sternal line at about the sixth costal cartilage

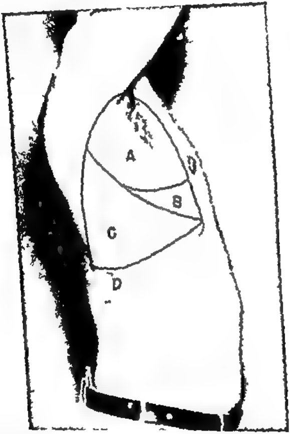

Fig 9 Topographic anatomy of lung and pleura as viewed from right side *A* Right upper lobe *B* Right middle lobe *C* Right lower lobe *D* Pleural reflection. *F* (Fig 10) Dome of diaphragm

On the right side the interlobar sulcus between the lower and the upper and middle lobes also begins at the fourth dorsal vertebra and swings laterally and downward to end at the sternal line also at the sixth costal cartilage The sulcus between the upper and middle lobes

Roughly, it may be said that, upon the left side, the major portion of the front of the chest corresponds to the upper lobe Posteriorly, the area below the spine of the scapula is related to the lower lobe In the axilla the upper portion represents the upper lobe, and the lower portion, the lower lobe Upon the right side, the major portion

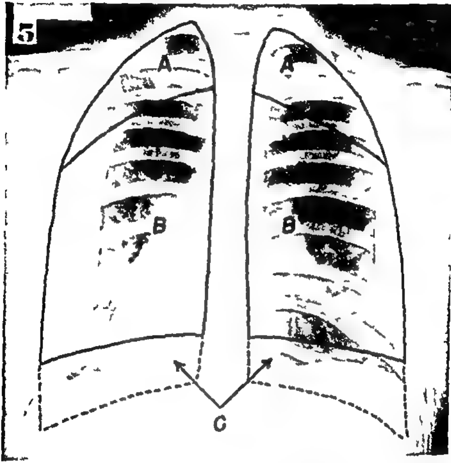

Fig 8 (Same subject as in Fig 7) Topographic anatomy of lungs and pleurae on x ray film as viewed from back

of the front of the chest represents the upper and middle lobes Posteriorly, the relationships are the same as upon the left side In the axilla a portion of the middle lobe projects into the axilla separating the upper lobe and lower lobe areas On each side a small triangular area in the lower lateral portion of the anterior aspect of the chest represents the lower lobes

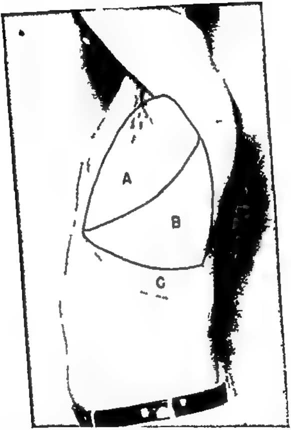

Fig 11 Topographic anatomy of lung and pleura as viewed from left side A Left upper lobe *B* Left lower lobe *C* Pleural reflection *D* (Fig 12) Dome of diaphragm

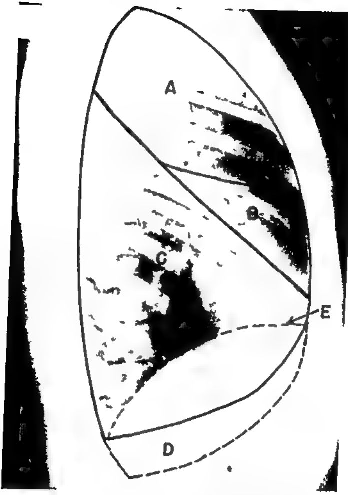

Fig 10 (Same subject as in Fig 9) Topographic anatomy of lung and pleura on x ray film as viewed from right side

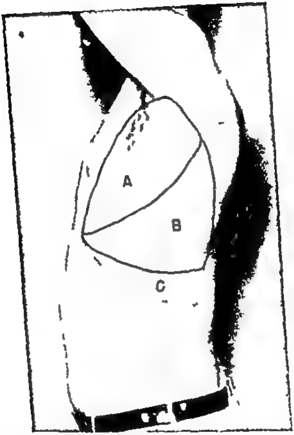

Fig 11 Topo raphic anatomy of lung and pleura as viewed from left side *A* Left upper lobe *B* Left lower lobe *C* Pleural reflection *D* (Fig 12) Dome of diaphragm

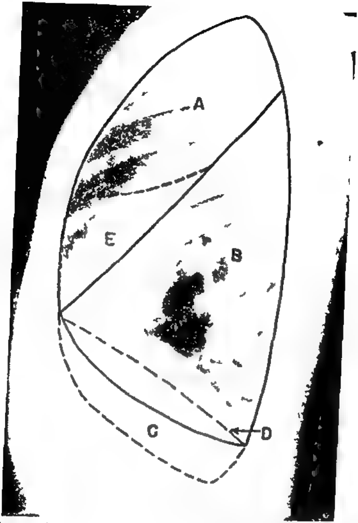

Fig 12 (Same subject as in Fig 11) Topographic anatomy of lung and pleura on x ray film as viewed from left side The lingula (E) of the left upper lobe is indicated by the dotted line

begins at the sternal line at the level of the fourth rib and extends horizontally toward the axilla to join the other interlobar sulcus at the fifth rib in the posterior axillary line

The lower border of the lungs on each side is as follows It begins anteriorly at the sixth costal cartilage crosses the eighth rib in the midaxillary line to end at the eleventh dorsal vertebra posteriorly

Inspection

The first requisite of adequate inspection is that the patient's chest be stripped of all clothing and placed in as good a light as possible,

in such a position that both sides of the chest are equally lighted Shadows may prevent the observation of important abnormalities at times such as pulsation for example due to intrathoracic vascular disease In addition the observer should inspect the chest from

Fig 13 Inspection of chest obliquely from above

several angles under certain circumstances For example the author has repeatedly picked up the pulsation of aortic aneurysm merely by inspecting the chest from several angles the pulsation being visible with a shift of the vision of *only a few* inches at times Unfortunately the physician must compromise with poor light all too often in the home

Technic Inspection of the chest may be carried out in the sitting position the observer being seated squarely in front of or in back of

the subject if he is sitting on a stool If the subject is seated on the examining table the observer can usually carry out inspection completely while standing in front of, or in back of the patient (In assuming the sitting position, the patient usually throws back his shoulders in a military position He must be instructed to relax his shoulder girdle and to drop his hands loosely at his side or in his lap Important abnormalities may be masked by expanding the chest and throwing back the shoulders) In either position, the examiner may

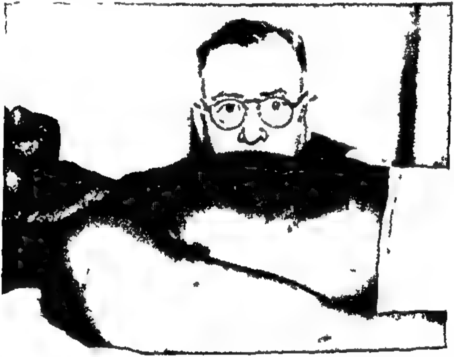

Fig 14 Inspection of chest in horizontal plane

move about or shift the patient if a view from a different angle seems desirable When the patient is lying on the table or in bed, the observer either stands or sits at one or other side for inspection

As was indicated in the foregoing in inspection of the chest for pulsation observation from an oblique angle may be preferable Thus, if the patient is sitting on a stool, the observer may stand behind the patient and look down at the anterior chest wall from above (Fig 13) If the patient is lying supine, the observer may sit down to bring the level of his vision to almost the same horizontal

plane as the anterior chest wall (Fig 14) The student must learn to use the chest towel over the breasts in his female patients to satisfy their modesty By shifting the drape the chest may be inspected satisfactorily even though in a piecemeal fashion

The first thing likely to attract attention upon inspection is the *skin* and any changes in it Since the examination of the skin in general has been discussed in Chapter 3 this subject will not be considered again However it should be pointed out that the skin of the chest anteriorly and posteriorly offers for observation the greatest expanse anywhere on the body It often presents an opportunity to study the lesions of skin disease unaltered by the effects of tanning as may be encountered on the exposed surfaces

The state of *nutrition* of the subject is manifested by the prominence of or the absence of the bony landmarks

The *contour* of the chest in the absence of *disease* is related to age and to the constitution

The *type* of chest in terms of constitution is very important since the description of the internal organs is so intimately related to this The examiner must interpret many of his physical findings only in light of constitution just as does the roentgenologist

Asymmetry in the size of the two hemithoraces usually is indicative of disease at times it may be due to congenital anomaly Occasionally one may see an example which is purely physiologic owing to excessive muscular development upon one side which in itself plus muscle pull produces a larger chest The most frequent example cited of such asymmetry used to be the blacksmith

Inspection must analyze the *respiratory movements* not only as related to the chest wall but also to the muscles of the neck and the abdominal movements

Finally inspection must take in all areas of the chest front and back for asymmetry tumors bulges pulsations and so on (The breasts were considered in Chapter 9)

Inspection of Normal Chest In the absence of cutaneous disease no particular comments regarding the skin are necessary at this point The chest is a site where the individual degree of hirsutism is first encountered in the examination With older age hairiness usually decreases in males whereas a few hairs may appear over the sternum

in some older women The blonde person shows normally in the untanned skin of the chest some degree of a tracery of veins with which one must be familiar in order not to mistake them for evidence of collateral circulation

The *nutritional status* of the person in terms of subcutaneous fat is obvious upon inspection of the chest In spare persons, elevations and depressions representing ribs and interspaces respectively, can be seen except in the areas covered by heavy muscles such as the pectoral and trapezius muscles Likewise in these persons the clavicles usually are easily seen and the supraclavicular space is likely to be slightly concave In those with moderate or great amounts of subcutaneous fat, the ribs and interspaces are not visible Also in the well nourished person the supraclavicular fossa is filled so that it becomes *flat or even convex* *In obesity, this area is definitely filled* out, and in middle aged fat women, definite fat pads develop here not uncommonly bringing them to the physician under the impression that a tumor is growing there In general women tend to have a greater amount of subcutaneous fat than men In moderately fat older persons there may be sagging of the tissues in certain areas especially in the mammary regions true even in the male

Contour and Size In infancy and childhood the chest contour in cross section is almost circular With puberty the chest changes to the adult configuration and thus in cross section is seen to be flattened in the anteroposterior diameter to present an oblong contour the widest lateral diameter being posterior to the midpoint of the antero posterior diameter From middle age on into the later years of life the chest becomes more emphysematous or of an increased diameter *especially in its upper portions, thought to be due to accentuation of* the normal dorsal curve as the result of degenerative changes in the intervertebral discs Later some kyphosis develops even normally The variations in contour in the absence of disease depend to a great extent upon the type of chest as related to constitution or build In the hyposthenic person there is greater disparity between the two diameters the anteroposterior diameter being less in proportion to the transverse diameter than in the hypersthenic person *where the former* more nearly approaches the transverse diameter (Fig 15)

As was pointed out on page 41 the constitutional make up of the subject must be kept in mind for the proper evaluation of the findings in examination of the thoracic organs Thus if the left border of the normal heart as measured from the midsternal line in the hypersthenic person were found to be the same distance from the midline in the hyposthenic person it would indicate cardiac enlargement Such findings therefore are relative

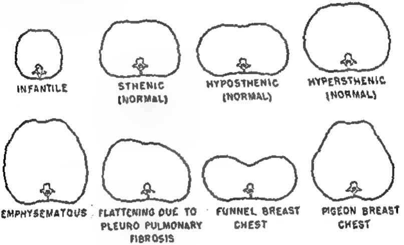

Fig 15 Chest conformations in cross section

In the *hypersthenic* person the chest is broad short and deep in the anteroposterior diameter and presents an obtuse subcostal angle (the angle formed at the tip of the sternum by the lower borders of the costal cartilages) The *hyposthenic* person presents the long narrow chest flat in terms of a small anteroposterior diameter and with an acute subcostal angle When these characteristics are extreme the subject is classified as 'asthenic' Finally the normal or *sthenic* person is one falling between the hypersthenic and hyposthenic in terms of length width and depth of chest presenting a right angle in the subcostal angle (Chapter 3)

Respiratory Movements The student should review at this point the anatomy and physiology involved in respiration as far as the chest

wall is concerned * At rest, the respiratory rate in adults is from 16 to 20 per minute An increased rate is observed often in the normal person because of embarrassment or the emotional distress occasioned by the examination

Having in mind the mechanism of respiration as related to the chest wall, the student physician should note the movements of the chest in the act of breathing In the absence of disease and at rest there is a difference between the sexes as regards the costal and diaphragmatic forces in the respiratory act In the male the major movement in

* *The chemical control of respiration will not be reviewed in this book since it is* a purely physiologic and biochemical process The anatomic considerations are worthy of brief mention since they offer the basis for certain physical findings

Inspiration is an active process involving the chest wall and the diaphragm All *portions of the lung do not move equally with expansion The degree of expansion* of any one portion of the lung is related to the extent of movement of contiguous portions of the chest wall The significance of this will be revealed later in this chapter and in Chapter 11 The lung expands interiorly laterally and downward The posterior aspect of the lung especially the upper portion moves very little

Keith has analyzed the respiratory mechanism as follows (1) The sternal manubrium and the first ribs move on inspiration to a more horizontal position thus increasing the anteroposterior diameter of the lung apex expansion being forward (2) The second to sixth ribs successively assume a more oblique angle and develop a greater curve as they are lifted outward from the spine On inspiration the third to sixth ribs become more horizontal and therefore project their anterior ends forward and upward thus pushing the sternum upward and forward The costal elevation is mediated by the external intercostal muscles acting against the first rib as a fixed point which is provided by contraction of the scaleni muscles *The second to sixth ribs* also increase the transverse diameter of the chest in inspiration for they rise like a bucket handle from the oblique position to horizontal level (3) The seventh to tenth ribs move laterally and upward like a bucket handle also increasing the transverse *diameter of the chest in its lower portion with widening* of the subcostal angle but slightly reducing the anteroposterior diameter (4) The diaphragm being the main muscle of respiration accounts for the major portion of air inspired upon deep inspiration At the height of expiration the dome of the diaphragm lies at the level of the fourth or fifth costal cartilages In quiet respiration it moves about 1 5 cm (3/5 inch) and on deep inspiration several centimeters During respiration the diaphragm retains its dome shape to some extent In inspiration the transverse diameter of the chest being increased the lung is permitted to descend into the costophrenic sulcus The costosternal portion of the diaphragm pulling against the lower ribs moves downward and forward pushing the abdominal viscera *down to distend* the abdomen The abdominal muscles and the recti and oblique muscles relax with the diaphragmatic descent and contract upon its ascent

Except in forced expiration when the internal intercostal muscles are brought into *active use expiration is a passive act following collapse* of the lung at the end of inspiration It is effected by the elastic recoil of the lungs and by the negative intrathoracic pressure which is at its height at the end of inspiration (Adapted from Best, C H and Taylor N B Physiological Basis of Medical Practice Williams and Wilkins Co Baltimore Maryland 4th ed)

quiet respiration is diaphragmatic in the female the costal element is greater (perhaps Nature's adaptation to the impediment of a pregnant uterus to diaphragmatic respiration) Thus as one observes the male lying quietly upon the examining table the upper chest moves little if at all the lower chest moves laterally upon inspiration

Fig 16 Use of hands in demonstrating respiratory movement of lower chest

the lower portion of the sternum may move in and the upper abdomen bulges forward In the female these features are less marked but the upper sternum and the infraclavicular areas move forward and the axillary areas move laterally Under the excitement of examination in the male the costal factor may become more evident

In order to evaluate symmetry and synchronism in the respiratory movements the observer asks the subject to breathe more deeply in

order to bring into full effect his costal respiration During this type of inspiration, the supraclavicular areas normally will fill out simultaneously, the infraclavicular and upper sternal area will move forward the transverse diameter will increase, and the abdominal wall will move outward

Fig 17 Use of hands in demonstrating respiratory movement of upper chest

The fingers may be brought into use in such an examination to demonstrate more readily inspiratory movement and also to gain benefit from palpation If the thumbs are laid along the margins of the tenth costal cartilages the tips meeting at midline over the tip of the sternum one can determine better asymmetry or asynchronism of movement by watching the thumb tips as they move laterally from the midline upon inspiration (Fig 16) A midsternal line drawn with a skin pencil is helpful In the infraclavicular area the use of the fingers is also helpful The hands are laid palm down upon the areas finger tips toward the sternum the fourth finger on the second rib

the third finger on the third rib and the index finger on the fourth rib A technic used more commonly is that of applying the hands with the fingertips directed toward the clavicles Upon inspiration asymmetry and asynchronism if present will be more manifest upon inspiration assisted by palpation (Fig 17)

During deep inspiration some retraction of the interspaces will be noted as intrathoracic negative pressure is increased during the act *

With forced inspiration one will note contraction of the sternocleidomastoid and scaleni muscles in the effort of raising the first and second ribs to increase the volume of the thoracic cage

PALPATION

This method of examination is used to amplify inspection and to make observations regarding the transmission of vibrations from the site of their production within the respiratory tract to the palpating hand

As was indicated under the discussion of inspection the examiner s hands may be used to make more evident the expansibility of the chest or of any of its portions Palpation also offers information relative to the texture dryness and moisture of the skin Furthermore the palpating fingers are used to determine the consistency and degree of tenderness of tumefactions or irregularities of the chest wall thus again amplifying what information may have been gained by inspection Muscle rigidity or tonicity are noted by touch The trapezius and pectoral muscles especially should be examined with this in mind In the absence of visible changes in the chest wall the exploring

* In the earlier days of physical examination much use was made of Litten s phenomenon In expiration the diaphragm lies in apposition to the chest wall as high as the sixth or seventh rib Upon *inspiration it peels off* from the chest wall with its downward movement. The expanding lung slips into the costophrenic sulcus Because of the increased *negative* pressure there is a *slight sinking* in of the intercostal spaces This is noted as a shadow moving *downward* upon inspiration and upward on expiration ranging from the sixth to the ninth ribs It can be demonstrated in most moderately thin or spare persons The subject must be recumbent upon a table the feet being toward a *window* so that the light is directed toward the head Slow deep abdominal *respiration* is needed This *is a test* of diaphragmatic excursion and therefore is known as the "phrenic wave This maneuver is practically never used any more Equally satisfactory information can be obtained by percussion

fingers may probe into those areas indicated by the patient as being painful in order to demonstrate tenderness objectively Visible pulsations may also be felt

Tactile fremitus as indicated on page 307, is the recognition by the palpating hands of vibrations set up in the thoracic wall In the normal chest, only tactile fremitus is present, in disease, other causes of fremitus may appear, and the vocal fremitus may be changed

The spoken voice is produced by vibrations of the vocal cords The laryngeal vibrations, audible as the spoken voice, represent modulations due to the resonating capacity of the nasopharynx and connecting structures In like fashion, the thoracic wall, being elastic, acts as a resonator for the vibrations transmitted to it by the structures of the respiratory tree just as does the body of the violin when the strings are bowed The chest wall therefore is thrown into vibration by the spoken voice, the vibrations can be felt by the examiner s hand resting upon the subject s chest In order to maintain a comparable vibration frequency the subject is asked to say over and over "one—two—three For the transmission of vibrations to become palpable at the chest wall it is obvious that certain conditions must obtain (1) The larynx must be functioning normally, (2) the pitch of the voice must have a sufficiently low vibration frequency to be palpable (thus tactile fremitus is more readily determined in the adult male than in the female), (3) the bronchial tree must be open, and (4) there must be nothing interposed between the lung and chest wall to break the vibrations as occurs in pleural effusion, for example In a thick chest wall, as in the obese or very muscular person, tactile fremitus is less prominent The more air there is in the chest, the better the fremitus —it is felt better during nspiration than in expiration

The technic of examining for tactile fremitus is that of placing the palmar surfaces of the fingers lightly on the bare chest wall or by using the ulnar border of the hand (Fig 18) (Too great a pressure deadens the sensitivity of the tactile corpuscles) In examination of the front of the chest the examiner sits or stands squarely in front of the subject and alternately places his fingers on like areas of the chest as the patient repeats the desired words By alternate examination of like areas of the two sides of the chest a comparison may be made of the intensity of the fremitus for diagnostic help

The fingers tips are used in the supraclavicular fossae Several areas in the infraclavicular and mammary areas are examined next (In the left mammary area the heart obviously will modify the fremitus) Then the upper and lower axillary areas of the two sides are compared for the intensity of the fremitus For examination of

Fig 18 Technic for eliciting tactile fremitus by use of either palmar surface of fingers or ulnar side of hand—right and left hands respectively

the back the examiner places himself directly behind the patient and by finger palpation compares alternately the supraspinous areas the interscapular areas and about the angles of the scapulas In use of the ulnar border of the hands may be more convenient than the fingers

Since tactile fremitus cannot be of equal intensity in all portions of the chest, and because overlying fat and muscles modify the degree of palpability, it is obvious that comparable areas should be compared Even here, there is some variation since there are differences in comparable areas of the two sides in the normal chest On the right

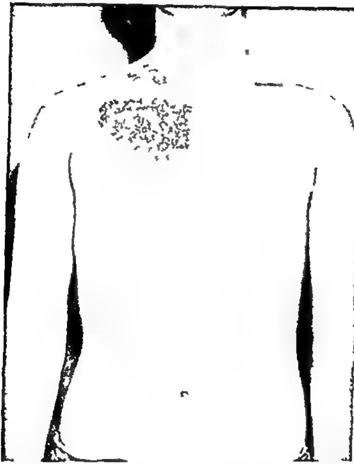

Fig 19 Stippled areas represent those in which (*a*) tactile fremitus is increased (*b*) percussion note is impaired or relatively dull (*c*) bronchovesicular breath sounds are present (*d*) voice sounds are more readily transmitted

side both in the supraclavicular space and in the infraclavicular area fremitus is more intense than on the left side The trachea lies in closer apposition to the right upper lobe thereby permitting more readily the transmission of tracheal vibrations to the lung and then to the hands (Fig 19) Bilaterally in the interscapular areas the fremitus is quite intense because of the proximity of the major bronchi

It is also more easily demonstrated over the intercostal spaces than over the rib (Fig 20)

In addition to the comments about increased intensity, if one uses the left infraclavicular area as a norm for comparison the following remarks may be made concerning tactile fremitus in the healthy per

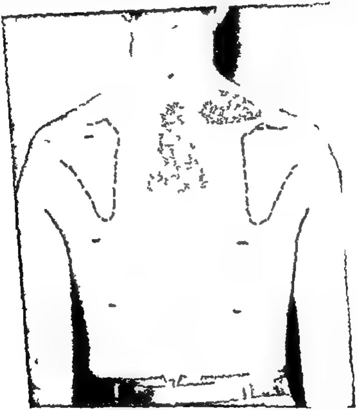

Fig 20 Stippled areas represent those in which (*a*) tactile fremitus is increased (*b*) percussion note is impaired or relatively dull (*c*) bronchovesicular breath sounds are present (*d*) voice sounds are more readily transmitted

son Fremitus is less intense in the axillas though more prominent high in the right axilla It is also less intense over the supraspinous areas though again the right side shows a greater intensity than the left Over the scapular areas tactile fremitus is very weak being a little stronger in the infrascapular areas though less intense than in

the left infraclavicular region In many subjects and especially in those with low pitched voices, tactile fremitus is greater over the whole right chest than the left The relatively straight course of the right lower bronchus in addition to the factors mentioned in the upper chest probably accounts for this

As was pointed out above, tactile fremitus is less well obtained in women and children than in men because of higher pitched voices Thick chest walls reduce tactile fremitus Over the breasts especially in women tactile fremitus is absent or markedly decreased

Even though young children have high pitched voices the small chest and especially its elasticity permit ready transmission of vibrations Anyone who has held a crying unclothed child recognizes this

The integrity of the intercostal nerves from a sensory standpoint may be tested by the palpating fingers Better yet, however, is the use of the pinpoint as was shown on page 60

PERCUSSION

This represents the third method of examination applied to study of the thoracic contents and is much more useful than vocal fremitus It requires much practice for mastery of the technic and interpretation of results Probably many physicians go through the motions of percussion for decades but never really become proficient in its technic The common use of the x ray study of the chest has removed much of the stimulus for the young physician to make himself proficient in this method of examination

In percussion, the chest wall is struck a blow with the purpose of setting up vibrations in the underlying tissues thereby producing a sound To the experienced clinician another element is introduced either to amplify the effect of the sound or even to replace it This additional factor is the sense of resistance felt by the finger in percussion This can be understood when one observes the clinician percussing while talking or carrying out his examination in a noisy ward Obviously he cannot hear accurately the sound produced by percussion but depends upon tactile sensation instead

Technic Percussion may be carried out by one of two methods *Direct* or *immediate* percussion is the act of tapping on the chest wall with the finger tips *Indirect* or *mediate* percussion is a technic

whereby a finger of one hand is placed on the chest wall and is struck a blow by the tip of one of the fingers of the other hand The finger applied to the chest wall is known as the pleximeter and the striking finger as the plexor (In some of the European countries and formerly in this country the pleximeter consists of an ivory bone or other small plaque and the plexor is a small hammer)

Fig 21 Technic of immediate percussion Fingers are partially flexed wrist action permits percussion with fingertips

Direct (Immediate) Method The direct method is not recommended as a rule for the student or beginner for it is in general a more crude method It may be used to demonstrate rather marked differences as in comparing the side of the chest containing much fluid with the unaffected side The direct method consists of sharply tapping the area to be tested with the tips of two or three fingers (second to fourth) The fingers are flexed to a right angle at the first interphalangeal joint the second and distal phalanges being approximately straight and perpendicular to the chest wall as the tips strike it An area is tapped twice and the sound compared with that produced in its like area on the other side of the chest (Fig 21)

Another method used by some clinicians in outlining the border of a solid organ like the heart, for example is as follows The palm of the examining hand is held only a slight distance from the chest wall, the middle finger is held rigidly extended, bending at the metacarpophalangeal joint to strike blows against the chest wall in a flipping sort of movement The striking area is the palmar surface of the distal phalanx A series of blows are struck as the hand is gradually brought at right angles across the visceral border to be outlined upon the chest wall (Fig 13, page 413)

Indirect (Mediate) Method Since the indirect or mediate method is in almost universal use, it will be described in more detail

Preferably the patient sits on a stool or examining table in a relaxed position, with the shoulders drooping forward to obtain relaxation of the trapezius latissimus dorsi, and pectoral muscles This is to reduce as much as possible the effect of muscular tone and bulk on the percussion note In examining the patient the examiner should be at the same level as the patient so that the hands may be moved about with ease The wrists are held in the midposition (hand and forearm being approximately in line) The hands may then be moved easily in an arc from one side to the other The student soon will find that he cannot get adequate apposition of the pleximeter finger to the chest wall if he is in such a position that the wrist is in hyperextension

During the examination of the front of the chest the subject permits his arms to hang loosely with his hands in his lap When the axillas are examined the patient places his arms akimbo places the hands on the iliac crests or clasps the hands behind his neck or head In examination of the back of the chest the head is permitted to fall forward and the arms are folded across the crest in order to draw the scapulas laterally and to uncover more of the lung field

Examination of the patient by percussion as he lies on a table or in bed is less satisfactory since either of these may dampen the vibrating chest and interfere with a clear note This is more often true in the young subject having a very elastic chest wall In the sick patient examination in the recumbent or lateral position is often necessary

The pleximeter finger (the middle finger) must be held firmly against the chest wall the amount of pressure to be exerted being

difficult for the student to judge * He should never use so much that the subject must resist the pressure The finger should not be applied so firmly that it is uncomfortable for the examiner since in addition to the discomfort such pressure will deaden the sensitivity of the tactile end organs However he must use enough pressure to com

Fig 72 Technic of mediate percussion Pleximeter finger is applied firmly to chest plexor (third finger) is poised for blow to be delivered by wrist action

press the subcutaneous tissue in order to obtain a relatively solid structure to be set into vibration † The point of maximum pressure by the pleximeter finger is the area of the second interphalangeal joint and the proximal portion of the distal phalanx The remaining fingers of that hand must rest very lightly on the chest wall adjacent to the pleximeter finger Any pressure by the remainder of the hand will

* It is essential that the examining hands be warm If they are cold muscular contractions or at least increased tone are set up to alter percussion notes shivering may ensue Examination in a chilly room has a similar untoward effect

† If the pressure is too light, the note will be muffled and not clear

Another method used by some clinicians in outlining the border of a solid organ like the heart, for example is as follows The palm of the examining hand is *held only a slight distance from the chest* wall the middle finger is held rigidly extended, bending at the meta carpophalangeal joint to strike blows against the chest wall in a flipping *sort of movement* The striking area is the palmar surface of the distal phalanx A series of blows are struck as the hand is gradually brought at right angles across the visceral border to be outlined upon the chest wall (Fig 13, page 413)

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clinicians including myself prefer the distal phalanx between the distal joint and the fingernail as the site of the blow The same spot must always be used by the examiner Two quick blows are usually struck in succession rather than one before moving to another spot since the sound may be fixed better in mind in this way (The musician tuning a stringed instrument strikes the piano key twice for the same reason)

Fig 74 Technic of percussion of front of chest examiner is seated facing patient Pleximeter finger rests in interspace parallel to ribs

In applying percussion to examination of the chest like areas on the two side must always be compared just as in palpation Obviously it would be fallacious to compare the note produced over a one inch thick trapezius muscle with that over the infraclavicular area where the tissue underlying the skin is less

A definite routine is necessary to be sure that all areas are examined in applying percussion Beginning at the upper front portions of the chest slight modifications are permissible The clavicles may be used as pleximeters direct *percussion* with the finger tips being used here to compare both sides For the sake of convenience the thumb of the left hand is used as a pleximeter in the right supraclavicular space the remainder of the hand resting on the upper border of the trapezius muscle In the left supraclavicular area the usual technic

dampen the vibration set up as certainly as something laid across the *vibrating strings of a violin* (Figs 22, 23)

The plexor finger (the middle finger of the right hand in a right handed examiner) is bent, the first interphalangeal joint being flexed at a right angle This finger is to act like a piano hammer, its objective being to strike the pleximeter finger a quick, sharp blow, moving

Fig 23 Technic of mediate percussion Moment of delivery of blow

away as promptly as does a piano hammer The blow is struck entirely by wrist action The error common to students is to hold the wrist stiffly in midposition and to direct the blow by movement of the elbow The elbow should be relaxed and move but little in correct percussion, the wrist movement delivering the blow (If the plexor finger does not come away quickly from the pleximeter, it will dampen the sound) The tip of the plexor finger strikes the area of the distal interphalangeal joint of the pleximeter finger * Some

* The blow must be struck at the site of pressure by the pleximeter finger If it is proximal to this point the note is not clear

clinicians including myself prefer the distal phalanx between the distal joint and the fingernail as the site of the blow The same spot must always be used by the examiner Two quick blows are usually struck in succession rather than one before moving to another spot since the sound may be fixed better in mind in this way (The musician tuning a stringed instrument strikes the piano key twice for the same reason)

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is used During the examination of the front of the chest the examiner sits in front of the subject the wrist of the left hand being held some slight distance from the sternum The pleximeter finger is always parallel to the interspace or rib He places the pleximeter finger in the first interspace on the patient s left, taps twice, then rotates the hand so that the same pleximeter finger falls into the comparable spot on the right side, two blows again being struck (Figs 24, 25) The maneuver is carried out at two or three points in each intercostal

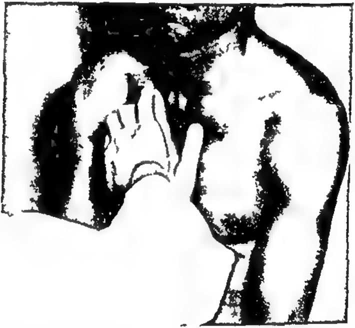

Fig 25 Technic of percussion of front of chest By rotation of pleximeter hand at wrist identical pleximeter pressure and plexor blow are possible in comparable area on contralateral side

space and over each rib always comparing the note over like areas alternately on the two sides that is comparing rib to rib and interspace to interspace

By this technic, the supraclavicular and infraclavicular areas are compared In the mammary areas the note on the left side is modified by the underlying heart The percussion sound of like areas in the axilla from top to bottom must be compared

Over the back the technic is varied Because the ribs and inter spaces are covered by heavy muscle it is less essential that the plexim

eter finger be held parallel to the ribs Now firm pressure can be made at right angles to the ribs without having to adjust to concavities and convexities Over the supraspinous areas the long axis of the pleximeter finger is held at right angles to the border of the trapezius muscle In the interscapular areas the pleximeter finger is placed parallel to the spine (Figs 22 23) In the infrascapular areas the same technic is used as was described in percussion of the anterior chest wall

In mapping the borders of solid organs such as the liver or heart the line of percussion is directed at right angles to the expected border at several points to note changes in sound and thus to outline the border

The strength of the blow by the plexor finger is most important in fact probably the most important factor in successful percussion *One should use the lightest blow possible to obtain the desired information over air containing tissue the most desirable blow by the plexor will be that producing a faint but clear sound* The lightest blow possible to produce a sound after penetrating the tissues of the chest wall is estimated to penetrate to a depth of about 3 cm (1½ inches) into the lung with a radius of about the same size The harder the blow the more tissue is thrown into vibration not only in depth but in diameter Thus if a tuberculous infiltration of several centimeters in diameter is lying for instance under the third left interspace in the midclavicular line barely audible percussion would record a change (Fig 26 at *A*) A hard blow by the plexor finger might throw one third or one fourth of the whole left upper lobe into vibration and the note of the air containing tissue would drown out any abnormal sound which might be localized over the small area of infiltration It must be remembered that heavy or loud percussion will throw into vibration organs (such as the liver heart or stomach) quite distant from the pleximeter site and thus alter greatly the sound produced by light percussion under that site Though light percussion is essential in the attempt to pick up small and superficial infiltrations somewhat heavier percussion is necessary to demonstrate solid areas lying deeper within the lung that is several centimeters beneath the pleura especially when the intervening lung tissue is air containing (Fig 26 at *B*)

Heavier percussion is necessary when one is dealing with an obese or very muscular subject More tissue between the pleximeter finger and the lung must be thrown into vibration before the latter is reached In very muscular men especially in examination of the back heavy

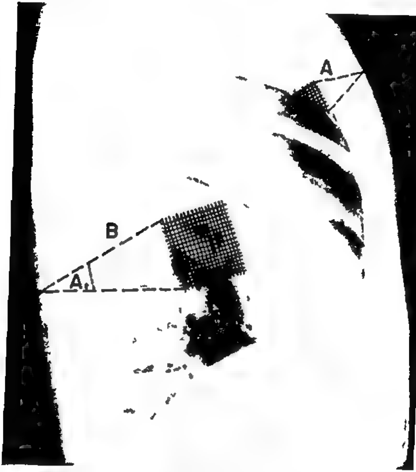

Fig 26 Diagram to illustrate effect of light and heavy percussion and their application to location of pathologic changes *A* Need for light percussion to demonstrate superficial small lesions *B* Need for heavy percussion to reach deep seated consolidation through intervening resonant lung *A*[1] Ineffectiveness of light percussion (as in *A*) in demonstrating deep lesion

percussion must be used The elasticity of the chest also varies In youth and young adult life the chest is more resilient and more readily thrown into vibration, therefore light percussion may suffice to attain the examiner s ends

Sounds By percussion sounds are produced which may vary in

(1) quality (2) intensity (3) pitch and (4) duration * These terms are essential in describing or in analyzing the sound produced upon percussion of the chest or abdomen

As Loewenberg has suggested, one may relate the characteristics of the sounds produced by percussion of the chest to air-containing tissue on the one hand and airless tissue on the other as follows (he includes the sense of resistance or tactile sense which was mentioned above)

	Air Containing Tissue	*Airless Tissue*
Quality	Clear	Dull
Intensity	Loud	Soft
Pitch	Low	High
Duration	Long	Short
Sense of resistance	Slight	Marked

Keeping these facts in mind consideration may be given to the sounds produced by percussion of the chest The student *must always* remember that all sorts of combinations of air containing tissue and airless tissue occur that the proportion of the one to the other varies greatly and that as a result many gradations may occur between the opposites listed in the table

Certain factors inherent in tissues determine the extent to which they are capable of vibrating These are as follows (1) the elasticity —the lungs are more elastic than the liver (2) the degree of tension of the tissue—the more taut the greater the vibration and the higher the pitch (3) the thickness of tissue—the thinner the tissue the greater the ease of being thrown into vibration and (4) the size of air containing space—pulmonary cavities as compared to alveoli may be thrown more *easily into* vibration

The terms used in describing the sounds obtained upon percussion are several *Tympany* is *not* heard over the normal chest except over

(1) Quality or timbre is due to overtones which give sound characteristics not present in another of the same pitch but produced in a different manner or by another musical instrument (In physical diagnosis the two extremes are the clarity of sound over air-containing tissue and the flatness of solid tissue) (2) Intensity is the loudness of a sound depending upon its quality the greater the clarity the more intense the sound (3) *Pitch* is an expression of the frequency of vibration of a sound — the greater the number of vibrations per second the higher the pitch (4) Duration is the length of time a sound is heard the length of the sound being related to quality clear sounds are heard longer than dull ones

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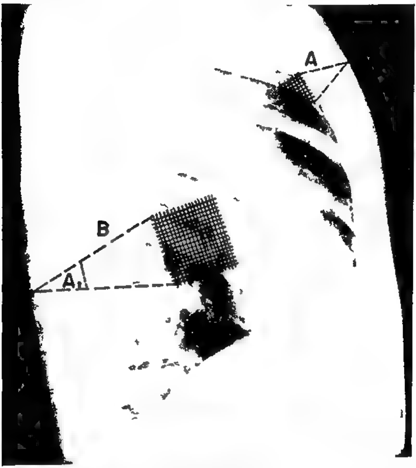

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percussion must be used The elasticity of the chest also varies In youth and young adult life the chest is more resilient and more readily thrown into vibration therefore light percussion may suffice to attain the examiner s ends

Sounds By percussion sounds are produced which may vary in

is a long quite loud clear low pitched sound As will appear below this may be *impaired* by adjacent airless tissue

Dulness is a nonmusical sound (noise) high pitched and of short duration and less loud than resonance The sense of resistance is easily felt *Flatness* is not present over the normal lung The student

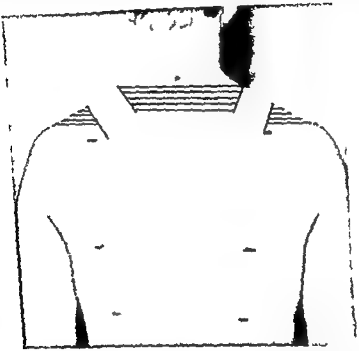

Fig 28 Kronig's isthmus (nonshaded areas over trapezius muscles)

may produce this high degree of dulness by percussing over his thigh *Relative dulness* is dulness modified by some air containing tissue

There are variations in the percussion note in the several areas of the chest and these must be learned by the student so that he may interpret his findings Again as was pointed out on page 317 it is essential that like areas on the two sides must always be compared in percussion Obviously it would be improper to compare the percussion note of the left infraclavicular area where there are no overlying muscles with the note produced over the thick trapezius muscle of the left interscapular area

Traube's semilunar space (page 324) It is the only musical sound obtained in percussion Tympany is a clear high pitched sound caused by a large volume of air in a cavity vibrating in unison with tense walls Though not heard over the normal chest it is heard by percussion over the stomach or colon in the healthy person It varies when the air

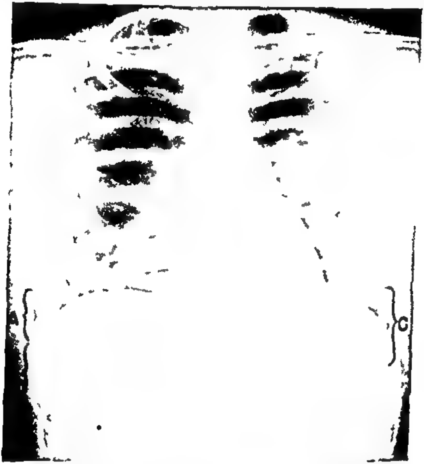

Fig 27 Variability of percussion note *A* Relative liver dulness or impaired resonance *B* Absolute liver dulness *C* Gastric tympany

containing cavity is closed and when it is open (The student can demonstrate this difference by percussing over his cheek with the mouth open then with the mouth closed and the cheeks puffed out)

Resonance is the nonmusical sound heard over the normal chest The thorax vibrates in unison with lung which has been thrown into vibration and thus amplifies the sound Its most pure form is heard on the left side at the infraclavicular area and in the upper axilla It

is a long quite loud clear low pitched sound As will appear below this may be *impaired* by adjacent airless tissue

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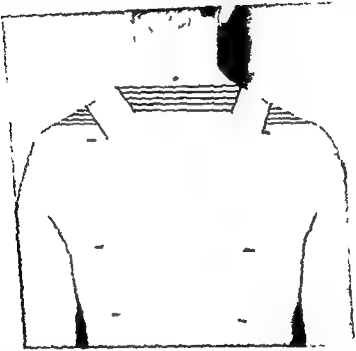

Fig 28 Kronig s isthmus (nonshaded areas over trapezius muscles)

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The supraclavicular areas are more resonant medially because of the trachea, laterally, resonance is impaired, more so on the right side where the lung apex does not reach so high a level as on the left *Also on the right side*, the innominate and subclavian arteries lie more superficially, offering airless tissue for modification of the percussion note (Fig 19)

As has been said the best example of resonance is elicited over the infraclavicular area and high in the axilla on the left side On the *right side, resonance is not quite so clear, since the right upper lobe* is a little more airless because of bronchial structures as well as being modified in the first and second interspaces by the great vessels (Fig 19)

Normally in the mammary area on the left side cardiac dulness *relative and absolute, occupies much of the area except in its* lateral portion On the right side, impaired resonance is present in the fourth interspace, and from here to the sixth rib, there is *relative dulness* the lung tissue in the costophrenic sulcus, being about 2 cm (⅘ inch) in thickness modifies the dulness of the airless liver (Fig 27)

In the left hypochondrium lateral to the midclavicular line and below the sixth rib, is *Traube s semilunar space* where tympany is encountered because of the air in the stomach This space is bounded above by the heart dulness, laterally by the spleen and medially by the left lobe of the liver The right hypochondriac area is dull upon percussion—the absolute dulness of the liver At times a tympanic quality is demonstrable due to the underlying dilated colon

The left axilla is resonant down to the dulness below the ninth rib In the right lower axilla impairment to relative dulness is present from the sixth rib to the eighth rib below which absolute dulness is present (Fig 27)

If the superior border of the trapezius muscle is percussed a resonant area can be mapped out some 4 to 5 cm (1⅗ to 2 inches) *in width on each side slightly narrower on the right than on the left* side This is called 'Kronig s isthmus and represents the width of the anatomic apex of the lung (Fig 28)

The suprascapular areas are resonant but slightly impaired having a higher pitch as compared to the front of the chest because of the thick trapezius and supraspinatus muscles The sense of resistance is

felt to be greater here also than in front Over the scapulas the sound is relatively dull because of the bony structure

Likewise the interscapular areas present an impaired percussion note because of the heavy muscle layer In the infrascapular area the muscles are thinner and here one finds the resonant note to be less impaired The resonance is not so clear however, as over the anterior

Fi 29 Limits of diaphragmatic excursion upon inspiration and expiration demonstrated by percussion

surface of the thorax The eighth and ninth interspaces and ninth rib present relative dulness on percussion because of the diaphragmatic dome and underlying liver Dulness is present below this

Diaphragmatic excursion may be determined by percussion much more conveniently than by demonstrating the Litten's phenomenon on inspection If the *subject is sitting* or standing relaxed the lowest border of resonance in the back and the axilla is determined in the midrespiratory position by percussion Then the subject is instructed to take a deep breath and to hold it Again percussion determines

the lowest border of resonance If a skin pencil is used to mark the two levels, it will be seen that upon inspiration the line of resonance moves downward 3 to 4 cm (1⅕ to 1⅗ inches) As many points as may be desired can be determined by percussion around the chest from the spinal line to the front The level on the right side will be about 1 cm (2/5 inch) higher than on the left because of the presence of the liver It is my routine practice in every examination to determine descent of the diaphragm in at least two points on each side of the chest at the scapular line and in the midaxillary line (Fig 29) (The complete extent of diaphragmatic excursion may be determined if in addition to the level in midposition and upon inspiration a third level is percussed at complete expiration In ordinary clinical work, this is not of especial benefit)

Percussion of Borders of Organs From what has been said it is clear that the liver and spleen may be outlined by changes in the percussion note In percussing for the borders of solid organs percussion should always begin over a resonant area and approach the dull area The impairment of *relative liver dulness* begins at the fourth intercostal space and extends to the sixth rib, this includes the area of the costophrenic angle Below the sixth rib the *absolute dulness* of the liver is present These levels may be carried horizontally into the axilla* (Fig 30) Cardiac dulness will be considered in Chapters 12 and 13 on heart disease

Variations in the Normal Variations of the sounds produced by percussion of the normal chest may be encountered under certain circumstances The student should test these to be familiar with them

In an elastic chest the normal resonance will change if the subject takes a deep breath and holds it The air spaces being overfilled with air and the walls being tensed a note approaching the tympanic character will be present, this is *hyperresonance* When the chest is held in the position of complete expiration, the note will deviate from normal resonance to one of slight impairment because the lungs contain less air Though percussion is not carried out in these extremes in the ordinary clinical examination the student should be familiar with these facts and mechanisms for similar changes may occur under the following circumstances

When, because of illness, the patient must be examined in the bed

certain facts must be kept in mind Seated by the bedside the physician examines the anterior thorax and axillas in a fashion as described for the seated person except for minor changes in the manual positions because of convenience In the absence of intra thoracic disease the degrees of resonance as noted in the seated sub

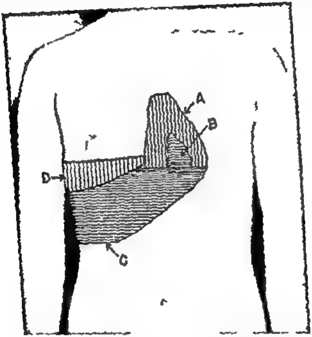

FIG 30 Outlines of changes of percussion note in mapping borders of solid viscera A Relative cardiac dulness B Absolute cardiac dulness C Absolute liver dulness D Relative liver dulness

ject will be much the same The dampening effect of lying on a bed may by decreasing the vibration of the thoracic cage impair the resonance slightly especially in young persons having an elastic chest

For percussion of the back the patient must lie first on one side and then upon the other The side upon which he lies will be com pressed to some extent through lessened expansion (less movement of the ribs) and by a shift of the organs (heart and liver) to that side in addition the dampening effect of the bed is more effective on the

the lowest border of resonance If a skin pencil is used to mark the two levels, it will be seen that upon inspiration the line of resonance moves downward 3 to 4 cm (1⅕ to 1⅗ inches) As many points as may be desired can be determined by percussion around the chest from the spinal line to the front The level on the right side will be about 1 cm (2/5 inch) higher than on the left because of the presence of the liver It is my routine practice in every examination to determine descent of the diaphragm in at least two points on each side of the chest at the scapular line and in the midaxillary line (Fig 29) (The complete extent of diaphragmatic excursion may be determined if in addition to the level in midposition and upon inspiration a third level is percussed at complete expiration In ordinary clinical work this is not of especial benefit)

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When, because of illness the patient must be examined in the bed

fat in young and in old in males and in females stands the physician in good stead He may upon percussion of only one side be able to judge whether abnormalities are present

The above comments apply if the patient lies on a firm mattress or on an examining table In the home if the patient is on a sagging spring and mattress lying on his side the spine may sag downward also permitting an approximation of the ribs on the uppermost side This prevents overexpansion of the lung of the upper side The

Fig 32 Impaired resonance (shaded area) of uppermost portion of chest because of approximation of ribs and resultant lessened lung volume due to sagging bed

contrast between the two sides thus will not be so great and in fact there may be some impairment of the percussion note in the area of greatest approximation of the ribs namely of the uppermost side (Fig 32)

Modifications of Percussion Several modifications of percussion will be mentioned for the sake of completeness

Auscultatory percussion combines the use of the stethoscope with direct percussion As the observer moves his stethoscope bell over the right chest for example and as the tapping finger (immediate percussion) approaches and passes the border of the airless liver a change in the sound is evident I feel that it offers no especial assistance over ordinary methods of percussion

dependent side By contrast, the uppermost side of the chest is expanded more than the usual in a mild sort of compensatory emphysema (Fig 31) Thus, the lowermost side of the chest will show decreased reasonance and the uppermost, some hyperresonance

Fig 31 Effect in young adult of assuming right lateral decubitus as shown by x ray film Lowermost portion of lung contains less air as shown by lessened translucency approximation of ribs with narrowed interspaces diaphragm is higher and heart is shifted downward (toward right) Uppermost lung contains more air as shown by increased translucency (darkness of lung field) widened interspaces and descent of left leaf of diaphragm

(The degrees of change are of the order described previously in the percussion of the normal chest during expiration and inspiration respectively) Obviously the physician cannot apply the dictum set up earlier that like areas should be compared they are not alike The patient may be asked to roll over and again percussion is carried out in order to decide if abnormal differences exist Still a question may arise as to whether the percussion note is abnormal Here the knowledge gained by having percussed hundreds of chests thin and

Auscultation as practiced in this country is of the *mediate* or *indirect* type and depends almost exclusively upon the use of a binaural stethoscope The monaural instrument began with Laennec s paper cone over a century ago It graduated into a wooden or hard rubber rigid instrument one end being applied to the chest wall while the examiner placed one of his ears to the other This type of stethoscope is still commonly used by European physicians The advantages of the binaural instrument are several Both ears are occluded thus reducing extraneous sounds and permitting greater concentration upon the chest findings The flexibility of the rubber tubes connecting the ear and chest pieces permits greater ease in the examination of patients in various positions and of those who are bedridden

There are two common types of chest pieces One is a flat circular piece 2 to 3 cm (4/5 to 1 1/5 inches) in diameter covered by a celluloid or other type of diaphragm (Bowles) (Fig 1 page 42) Its advantages are that (1) it can be slipped under the back of a very ill bedridden patient without disturbing him (2) since it magnifies sounds it is helpful to physicians who are deafened and (3) it is especially valuable in recognizing certain faint high pitched cardiac murmurs I do not recommend it for the novice however because he hears too much The beginner has difficulty in evaluating and interpreting the sounds heard over the chest wall whether they originate within the lung or without it The Bowles chest piece by amplifying the sounds makes the problem greater Therefore the *bell* type is recommended for student use *

The wall of the rubber tubing should be thick 3 mm or so in thickness thereby transmitting less of extraneous sound The length of the tubing is an important factor in auscultation since the stethoscope s acoustic efficiency increases with shortening of the rubber

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The student must select the correct earpiece which comes in three sizes If it is too large for the external auditory meatus the opening is not adequately plugged and noises from the outside will be a nuisance If the piece is too small it will slip into the meatus will not plug it adequately and will be uncomfortable because of pressure on the wall of the canal The metal tubes to which the earpieces are attached are bent with two angles These are important as related to the configuration of the auditory canal of the user If the angles are not correct the opening of the ear piece may be driven either against the anterior wall or against the roof of the auditory canal and thus lead to imperfect hearing

Orthopercussion is supposed to supply greater accuracy in outlining visceral borders, as in the case of the left border of the heart This is alleged to be accomplished by a pleximeter of smaller diameter In this method the finger tip is the pleximeter The pleximeter finger is bent at the first interphalangeal joint, the middle and distal phalanx being held in a straight line and perpendicular to the chest wall The plexor finger strikes the pleximeter finger at the distal end of the first phalanx Again, I question if anything more is to be gained than by the practiced, usual method of percussion (Historically this method is of interest representing an effort to attain greater accuracy in physical examination before the days of modern roentgenologic technics)

Coin percussion has its application under one circumstance to be noted in Chapter 11 This maneuver employs the stethoscope which is applied on either the anterior or the posterior surface of the chest An assistant then places a coin (nickel quarter or half dollar) on the opposite surface as a pleximeter and taps it with the edge of another coin the plexor Normally, a metallic tapping is heard In the presence of pneumothorax a bell like or reverberating sound may be heard

AUSCULTATION

The fourth and last method of obtaining information about the thoracic organs is by auscultation

An old method probably used for centuries is *immediate* or *direct auscultation* the application of the examiner s ear directly to the subject s chest wall This fell into disuse with the development of the stethoscope Direct auscultation is to be avoided for aesthetic reasons and because of feelings of modesty on the part of female patients Nevertheless it should be realized that one can examine the chest in this manner if necessary If one must use direct auscultation a handkerchief or gauze spread between the chest wall and the ear satisfies any feeling of delicacy on either the patient s or examiner s part Some physicians in their obstetric practice use direct auscultation to listen to the fetal heart sounds during labor applying the ear to the woman s abdomen especially when assistants are not at hand to adjust a head stethoscope

grating sound *Contraction of muscle* produces a creaking sound The student should listen over the pectoral or trapezius muscles while the subject is contracting these He will then understand why muscular relaxation and absence of shivering are essential in physical examination of the chest *Joint movement* produces a rough grating sound heard when the bell of the stethoscope is placed adjacent to a moving joint If the chestpiece rests on a hairy chest its movement on the hair leads to a crackling sound * If the student will twist his stethoscope so that the two rubber tubes rub one over the other a scraping sound is heard If the bell is placed on cloth covering the chest a scratching sound will be heard If the fingers holding the bell against the chest wall slip on the instrument a sound is produced Likewise if these fingers are so low on the bell as to touch the chest wall they will move with respiration producing a frictionlike sound At times the part of the bell which is placed on the chest wall and which screws into the remainder of the chestpiece becomes loose producing a clicking noise when heard through the stethoscope The student should produce all these extraneous sounds for himself As certainly as it has happened to every student at some time he will diagnose a *friction rub from the rubbing* of the stethoscope tubing or from the bell s movement on the skin Just as certainly he will describe rales misinterpreting muscle sounds or the sounds produced by the hairs on the chest wall †

Breath Sounds As was indicated on page 332 one of the objectives of auscultation over the lung fields is to evaluate the breath sounds For *th s examination* it is preferable to have the patient sit in a relaxed position as was described under the discussion of the technic of percussion *(see page 314)* Since the same areas as were percussed are to be listened to the same positions are desirable

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* If hair interferes too much with an essential examination it may be necessary to wet the hair with water or to apply petroleum jelly or mineral oil

† I have encountered other extraneous sounds with my students The more complicated stethoscope having a chestpiece with both a diaphragm and a bellpiece has a valve to be turned as one or the other is used When *th s valve* becomes loose from wear it produces an extraneous sound Occasionally as the spring of the metal binaural piece loses its tension a student may use a rubber band as an adjunct stretched from one tube to the other As this is only a couple of inches from the wearer s nose breathing may set the rubber band into vibration producing a remarkable musical sound as heard within *the stethoscope*

tubes (This is true for sound waves between 100 and 1000 cps) Tubing 7 5 cm (3 inches) in length may be the most efficient but is inconvenient The shortest tube which is still convenient for use is 25 cm (10 inches) in length It has also been shown that tubing and the metal binaurals of the stethoscope, if of a bore of 3 mm (⅛ inch), have a much greater efficiency in low pitched heart murmurs than those of larger bore

The purpose of auscultation of the lung areas of the chest is to hear and evaluate the breath sounds and any adventitious or abnormal sounds which are produced in the respiratory tract

Technic In learning to use the stethoscope, there are several fundamentals to be considered The chest wall must be bare, the stethoscope cannot be used upon a cloth covering the chest The room and the chestpiece must be warm A chill or shivering of the patient will make auscultation valueless The patient must be in a position permitting muscular relaxation In comparing areas of the chest, comparable anatomic areas must always be chosen The chest piece must be evenly and firmly applied to the chest wall if a portion of the circumference of the chestpiece is lifted from the chest wall a roaring sound appears This is of practical significance in the case of emaciated patients In such persons, it is impossible to use the stethoscope adequately over the front of the chest since the bell cannot be applied evenly to the wall it is balanced on a rib or bridges an interspace by resting upon two ribs

The amateur must learn to disregard many sounds which he hears and which are not of importance Obviously he must learn to dis regard the sounds produced in the environment on the ward in the corridor, or on the street adjacent to the building The earpieces *make these less prominent but do not completely* exclude them When he listens to lung sounds, he must be able to disregard the heart sounds over the adjacent organ, and vice versa

Of greater importance is the recognition for what they are, and the exclusion from conscious hearing of the sounds produced in the body, or listening circuit The student s initiation in the use of the stethoscope should include the production of all the sounds which will be encountered so that he will recognize them

Friction of the chestpiece by movement on the skin produces a

as well as by reflection from septums in the lungs and from the alveolar walls Another sound of a different pitch is heard over the chest and is presumed to be due to a swish of air into and distension of the alveoli Thus breath sounds heard over the lung areas probably originate from more than one pure factor

Breath sounds are described as being either *vesicular* or *bronchial* The former type is heard over the lung fields at a distance from the major bronchi and probably represents an alveolar source (The bronchial system is so buried in poorly conducting pulmonary parenchyma that its characteristic sound is lost) At the other extreme is the *tubular* or *bronchial* type undoubtedly originating in the tubular portions of the respiratory tree The bronchial type is much like that heard over the trachea Between these two is an admixture *broncho vesicular* the accentuation upon the bronchial element or upon the vesicular element being related to the proportion of patent vesicular tissue overlying the bronchi *

Pottenger has maintained that the accepted concepts of the origin of the breath sounds are fallacious He feels that the respiratory murmur is a complex composite of vibrations arising in the air column larynx trachea bronchi alveoli lung tissue pleura bony cage and muscles—*intercostal* diaphragmatic and abdominal In his opinion the glottis plays little part since breath sounds are heard unaltered *even if* the larynx is bypassed by a bronchoscope He assumes a muscular element in the respiratory sound since *similar sounds* may be heard over a contracting biceps or abdominis rectus muscle It is his feeling that the air column and air spaces are *incidental* to rather than important factors in the production of the breath sounds since the force of the tidal air would be nullified by the residual air diffusion being the major factor in air getting to the alveoli and smaller bronchi (Pottenger F M Auscultation A New Conception of the Respiratory Murmur and Its Place in Diagnosis Am Rev Tuberc 60 639 1949 Auscultation A Discussion of the Cause and Characteristics of Respiratory Sounds Trans Am Clin & Climatol A 59 159 1947)

This latter is not so negligible as Potten er would have us believe An ordinary inspiration involves the inhalation of about 500 cc of air About 150 cc of this fills the dead space (respiratory passages from the nostrils to the terminal bronchioles) the remainder (350 cc) plus the displaced 150 cc of air from the dead space moves into the alveoli The negative" pull on the lungs at inspiration distends the alveoli actively for the entry of air from the dead space and from the tidal air (Best C H and Taylor N B The Physiological Basis of Medical Practice The Williams & Wilkins Co Baltimore 1945 pages 297 311)

One observer has estimated that at *one* application of the stethoscope bell the observer might hear the *combined* sound of 1 400 000 alveoli at one inspiration It seems likely that the movement in such a number of alveoli would give rise to an audible murmur (Norris G W and Landis H R M Diseases of the Chest and the Principles of Physical Diagnosis W B Saunders Co Philadelphia 1938 page 171)

As the patient sits breathing quietly, little can usually be heard as the stethoscope bell is placed on the chest wall. Nevertheless, it is worth while to listen over the chest during such quiet breathing, for if at some area breath sounds are well heard, it is likely that disease is present in the lung under this area of the chest wall.

In order to hear the breath sounds well it is usually necessary to have the patient breathe a little deeper than *in quiet respiration*. In this way, enough air will move down the respiratory tree and a sufficient number of air sacs will be filled to produce the breath sounds. To obtain the desired effect, the patient is instructed to breathe with his mouth partially open and to inhale actively. (It is best to have him use breathing of only moderate depth.) Then expiration is permitted to take place as a purely *passive* act by recoil of the lung and chest. *Forced expiration must not be permitted!* It is well for the examiner to demonstrate to the patient how he is to breathe. The student will be astonished at the number of patients who cannot breathe voluntarily as directed. If the subject cannot breathe properly the same effect may be obtained by having him count until he is breathless, then the respiratory act will be of the desired type. (This is time consuming and tedious for both the patient and the examiner.) As the more distant portions of the lungs (the bases) are examined the depth of inspiration may need to be increased. *If the breathing is not of the desired kind as described the observer must be careful in his interpretation of the breath sounds. By forced expiration the breath sounds of pulmonary disease may be simulated.*

For years there has been discussion as to the origin of the breath sounds. It is likely that two sources of sound play their parts. If one listens over the trachea at the suprasternal notch and if the subject breathes as described above an inspiratory and an expiratory sound is produced. It seems likely that this is due to air passing through the glottis and larynx setting the trachea into vibration as a result of the turbulence of air flow caused by the laryngeal narrowing. The tracheal vibration is transmitted downward to the major bronchi and finally to the bronchioles. Here again turbulence caused by the breaking of air flow into the branching of the tracheobronchial tree is a factor in the vibration of this structure. As this sound progresses it loses intensity by diffusion into the pulmonary tissue and the chest wall.

The definition of these three types of breath sounds is in terms of pitch intensity and duration of inspiration and expiration It has been common practice for years to define these graphically as appears in Fig 33 Here the pitch of inspiration and expiration is shown by the angle of the gable The intensity is shown by the width of the line Thus vesicular breathing has an inspiratory phase about four times that of expiration the former being of a little higher pitch than the latter Bronchial breathing has a high pitch in each phase, more so in expiration which is longer than in inspiration Broncho vesicular sounds are of gradations dependent upon the proportion of the vesicular to the bronchial elements though the expiratory sound lasts to the actual end of inspiration Breath sounds may be compared as modified from Loewenberg as follows

	Vesicular	*Bronchovesicular*	*Bronchial*
Quality	Vesicular or breezy	Muffled blowing	Blowing tubular
Intensity	Soft or feeble	Somewhat harsh	Harsh
Pitch	Low	Between vesicular and bronchial	High
Duration	Inspiration longer than expiration	Inspiration equals expiration	Expiration longer than inspiration

The breath sounds often will be modified somewhat by certain factors in the normal In childhood because of the greater elasticity of tissues and better vibrations the vesicular sounds are more harsh and are called puerile In older persons because of decreased resilience the vesicular sounds are more feeble and seem distant with some increase of the expiratory length because of slower recoil Women may have more intense breath sounds in the upper chest than men do because as was noted before (see page 305) they have a costal type of respiration rather than the diaphragmatic type charac teristic of males Much subcutaneous fat and heavy musculature may decrease the intensity of breath sounds

One physical fact may be mentioned here so that its significance will be better understood in Chapter 11 Vibrations or sounds are trans mitted best by solid structures and this fact is the key to the use of

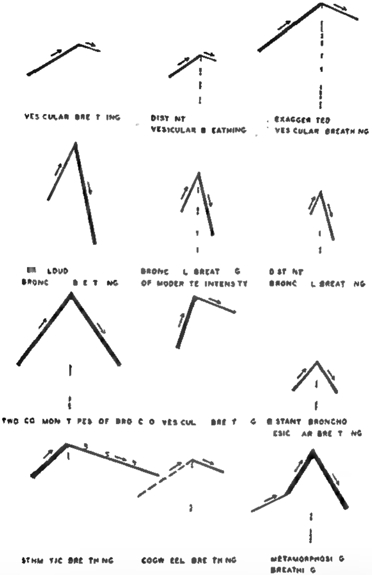

Fig 33 Breath sounds Left hand line represents inspiration right hand line expiration In each length of line represents duration thickness represents intensity and angle it makes with perpendicular (dotted line) represents pitch (Youmans J B Essentials of the Diagnostic Examination Oxford University Press Adapted from Cabot R C and Adams F D Physical Diagnosis The Williams & Wilkins Co)

Over the *scapular areas* little is heard In the *interscapular areas near the spine* the sounds are *bronchovesicular* since the stethoscope bell is over the root of the lungs Because of this the bronchial sounds from the major bronchi come through less modified by the smaller amount of vesicular tissue than over other areas of the chest (Fig 20)

Over the *infrascapular areas* the breath sounds are vesicular, more distant than over the front of the chest because of the thicker muscles of the back Furthermore there is less expansion of the posterior portions of the lung than of the anterior parts The sounds are especially feeble or distant over the lower margins where only the lung tissue filling the costophrenic sulcus provides the sound

Effect of Position Just as in the application of percussion to the bedridden patient so too variations in auscultation may be affected by position The descriptions given above apply to the upright position If the bedridden patient must be examined as he lies first on one side and then upon the other the examiner must keep certain facts in mind The side upon which the patient lies is more compressed and expands less Thus the breath sound may not be the *pure* vesicular sound anticipated but will have a bit more of the expiratory prolongation (Fig 31) This may not be true if the patient lies on a bed sagging so much that the uppermost chest is partially collapsed by the approximation of the ribs owing to the temporary scoliosis Under such circumstances the findings may be reversed (Fig 32)

Vocal Fremitus The sounds set up by the spoken or whispered voice are used in diagnosis also being spoken of as vocal fremitus comparable to the tactile fremitus described under palpation (page 308) The vibration of the *spoken voice* heard over the normal chest as the subject repeats ninety nine or one—two—three is heard as a blurred buzzing sound the words not being distinguishable

The *whispered voice* sound is tested with the same phrases the whisper must be very soft so that it has a limited transmission In the normal chest it may be heard only not as distinct words over the distribution of the major bronchi and trachea Therefore it is audible close to the sternum in the first and second interspaces anteriorly

breath sounds in recognizing pulmonary disease Therefore it should be emphasized here that bronchial or tubular, breathing is *never* heard in a normal chest since there is no solid structure in the lung to transmit vibrations set up in the trachea and bronchi unmodified by air containing tissue (To find a type of tubular breathing in the normal person, it was suggested on page 335 that the stethoscope bell may be placed over the trachea) Actually there is no point in doing this in the routine clinical examination Furthermore, such tubular sounds are really more harsh than the true bronchial breathing heard in pulmonary consolidation) *Thus, only vesicular and bronchovesicular breath sounds are heard over the lung fields under normal circumstances*

Vesicular breathing will be heard at its best and in its most pure form, as was resonance, over the left infraclavicular area and high in the left axilla

In the *supraclavicular areas* vesicular breath sounds are heard on the left side, by contrast greater prolongation of expiration on the right side causes the sounds to approach the bronchovesicular type This is true for the same reason that a variance is noted in the next area to be examined (see Fig 19)

In the *infraclavicular area* on the left true vesicular breathing is heard On the right side owing to a more direct bronchial route and less air containing tissue as was noted under the discussion of percussion (see page 324) the breath sounds are of the bronchovesicular type (If the type of sounds heard in the healthy person on the right side were heard on the left side, disease would be present) (See Fig 19)

The *mammary areas* bilaterally show vesicular breathing essentially of the same degree

In the *axillas* vesicular breathing is to be expected The upper right axillary area will provide longer expiration than on the left for the anatomic reasons noted above

The two *suprascapular areas* show contrasting variations of vesicular breathing as was noted under the description of breath sounds at the supraclavicular areas In addition as one listens close to the spine the sounds may be more harsh because the spine acts as a resonator (Fig 20)

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occupations in which a youth in his growing period might have more or less continued pressure against this area notably in shoe repair work, the last commonly being held firmly against the lower chest Not uncommonly, congenital shortening of the central tendon of the diaphragm is probably a cause of funnel chest (Fig 15 page 303)

Fig 5 Scorbutic rosary As result of separation of costochondral junctions and depression of cartilaginous portion ends of bony portions of rib are prominent

Accompanying *scoliosis* developmental or due to spinal disease especially in early life mild to extreme degrees of chest deformity may occur These are always asymmetrical On the side of the convexity of the scoliosis, the ribs are separated abnormally and the chest is larger, the lung being emphysematous, on the concave side the ribs may be so placed that there are no demonstrable interspaces and the

Fig 6 Funnel chest

ribs may actually override each other leading obviously to a small chest Thus one half of the chest is ballooned out the other markedly flattened (Fig 7) (In the more marked degrees of such deformity the physical and x ray findings of the lungs as will appear below may be difficult or impossible of interpretation)

Among elderly women one occasionally may still find an example of the marked constriction of the lower costal regions resulting from tight (corset) lacing in vogue several decades ago Other forms of congenital and developmental abnormalities in chest contour are encountered at times

A symmetrically *flat chest* other than that characteristic of the healthy asthenic individual may develop as the result of bilateral pulmonary tuberculosis or of other chronic inflammatory lesions which cause pulmonary fibrosis and adhesive pleuritis with retraction of the ribs* (Fig 8)

---

* Occasionally in neurologic disease as in poliomyelitis and in spinal-cord disease there may be paralysis of the intercostal and other accessory muscles of respiration with uniform narrowing of the intercostal spaces and sagging of the ribs

On the other hand, the *barrel chest* ■ a result of long standing emphysema, notably in chronic asthma and in occupations such as glass blowing, and to some extent from the physiologic changes of old age Such ■ chest appears to be in a state of permanent inspira

Fig 7

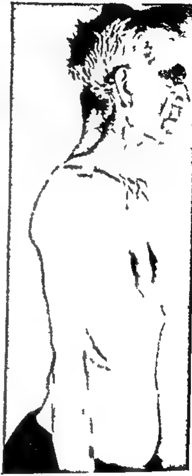

Fig 8

Fig 7 Postparalytic scoliosis (anterior poliomyelitis) Right chest is flattened and collapsed left is abnormally voluminous

Fig 8 Flattening of chest and retraction of ribs as result of diffuse pulmonary fibrosis

ion The anteroposterior diameter of the chest is increased, there is ften ■ dorsal kyphosis, the shoulders are forward the neck becomes hick owing to hypertrophy of the accessory muscles of respiration the ibs become elevated the intercostal spaces are wider, and the dia

phragm remains partially depressed As a result of these changes the respiratory movements of the chest are greatly limited (Fig 9, Fig 15 page 303) The emphysematous subject is unable to deflate the lungs as completely or as rapidly as the normal subject (Fig 10)

Fig 9 Barrel chest of emphysema

Asymmetrical changes in the contour of the chest are of greater significance in disease since they often point to not only the site of disease but also frequently to the type of underlying disease

Unilateral decrease in the size of the chest or flattening of the contour either over the whole side or in a localized area is a common finding (Fig 15 page 303) The most frequent cause is adhesion of the parietal and visceral pleurae (symphysis pleurae) as occurs fol

lowing pleuritis, accompanied always by some degree of underl pulmonary fibrosis and thus less air containing lung tissue Bec of these factors, the ribs and interspaces are pulled upon cat narrowed intercostal spaces and sagging of the ribs Thus there

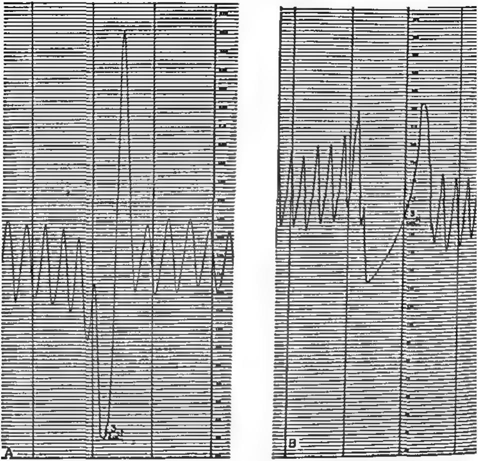

Fig 10 Timed vital capacity in normal (A) and emphysematous (B) subje (The spirograms are recorded from right to left) *A* Normal More than ninety per cent of the total vital capacity volume is moved out of the lungs in 3 secoı *B Emphysema There is a decrease in the volume of air (vital capacity)* which be moved out of the lungs more time is required for the exhalation because of elements of bronchial obstruction and loss of elasticity

flattening out of the normal convex contour In the localized forr this is well illustrated in tuberculosis of the upper lobe where t supraclavicular fossa is retracted deeply and the infraclavicular area flat In the lower chest, an excellent example may be seen followı pneumococcal empyema Because of the thickened and adhere

pleura, there may be flattening of the lower axilla and of the mammary and hypochondriac regions

In atelectasis of one lung or of a lobe due to obstruction of a bronchus the air is absorbed resulting in collapse of the lung The space is partially filled by a falling in of the ribs and thus there is a reduction in the size of the chest on that side either in its entirety or only partially In the case of the latter it is usually seen at its best in the lower portion (Figs 15 18)

Unilateral decrease in the size of the chest will accompany any neurologic disease which paralyzes the muscles of respiration In hemiplegia for example the paralysis of the trapezius scalene and intercostal muscles is accompanied by a narrowing of the inter paces and sagging of the ribs on the affected side

An asymmetrically enlarged chest is characterized by greater elevation of the ribs and less depression or even actual bulging of the inter spaces than on the normal side Again this may be general or localized More often it is the latter and may be noted especially in the lower chest that is in the axillary and mammary regions The most common cause of such asymmetry is pleural effusion Massive consolidation of a lung or of a lobe as in lobar pneumonia may be the cause (Figs 19–21) In the presence of pneumothorax under rather marked positive pressure, and in unilateral emphysema due to bronchial obstruction the whole hemithorax may appear increased in size (Fig 18)

Respiratory Movements From the foregoing the student might ask whether asymmetry of the whole hemithorax on inspection can be correctly interpreted in terms of which side is normal and which contains disease Respiratory movement will be of assistance The abnormal side whether smaller or larger will not move as promptly nor as well as the normal Thus by observing the examining hands applied to the chest as described in the preceding chapter one may demonstrate a lag of any part of the chest wall on inspiration Expansion begins slightly later on the affected side or there may be noted a definite decrease in total expansion If there is paralysis of the muscles of respiration there will be no movement of the affected side

Lag on inspiration may be noted under other circumstances than those due to pleural adhesions or pulmonary fibrosis (Figs 14 28)

Notably this also accurs in regions of pulmonary inflammation where air cannot enter or in which it enters in a lessened amount (Figs 19–21, 26, 27) Therefore, in early *tuberculosis of the upper lobe* the infraclavicular area, though not flattened, may show a lag upon inspiration (Spasm of muscles overlying inflammation may be a factor in lessened expansion)

Having come to the act of respiration and its movements in analyzing chest expansion, other things will be noted also In air hunger, the accessory muscles of respiration will be seen to contract as was described in the chapter on the abnormalities seen in the neck The muscles referred to are the trapezius, the scalene, the sternocleidomastoid, and to some extent the pectoral muscles

Other deviations from the normal respiratory movements may be noted under certain circumstances Because of disease in the upper mediastinum the greatest respiratory movement may occur in the lower portions of the chest In abdominal disease especially of an inflammatory nature such as peritonitis, there is reflex splinting of the diaphragm and the respiration is costal This is a valuable sign especially in men Similarly if there is increased intra abdominal tension, as in the presence of ascites large ovarian cysts, and the like respiration is of an exaggerated costal type due to encroachment upon the air volume of the lower portions of the lungs

Localized or unilateral decrease of respiratory movements may occur as the result of disease of the chest wall which causes pain on movement As a result, splinting of the area or entire side occurs reflexly Acute pleuritis, fractured rib, intercostal neuritis herpes zoster, and the like are examples of localized lesions which cause chest pain

In obstruction of the respiratory tree seen at its best in children having aspirated a foreign body, the negative intrathoracic pressure is greatly increased (Figs 17, 18) As a result there will be noted retraction of the structures at the base of the neck and the costal margins will be seen to move inward The actual respiratory excursions are greatly diminished The decreased respiratory excursion and the abnormality of the costal margin may be unilateral or bilateral the latter if tracheal obstruction is the cause the former if a bronchus is occluded (In infants without obstruction and having respiratory distress, the rapid respiration alone may cause bilateral retraction of the costal margins)

With massive pericardial effusion resulting in a depression of the diaphragm and thus altering its mechanics on inspiration, the left subcostal margin does not move *laterally* upon inspiration but remains stationary or may actually move medially This is known as Hoover's sign

In bronchial asthma *expiration* will be seen to be prolonged over inspiration since forced expiration is used to empty the lung against physiologic bronchial narrowing (There is also an inspiratory difficulty) If painful conditions of the chest wall exist inspiration may be broken from a smooth *continuous* movement into several broken or intermittent movements owing to reflex interference in muscular contraction because of pain

Respiratory *Rate* and Rhythm Leaving the respiratory movements as such we come to changes in rate or rhythm of the respiratory cycle

Hyperpnea represents an increase in the depth of respiration and usually is accompanied by an *increased rate* *Tachypnea* defines an increase in respiratory rate In the healthy person these occur in varying degree with exertion and to meet various physiological needs such as pregnancy In congestive heart failure fever anemia increased metabolism and any pulmonary disease with a decrease in the normal amount of gas exchange the need for oxygen causes hyperpnea In intracranial disease with irritation of the respiratory center and in pain hyperpnea is of central nervous origin The rate of respiration may be increased when there is a limit to the depth of inspiration as in peritonitis and increased intra abdominal tension with limitation of the diaphragmatic movement It also occurs in painful conditions of the chest wall

Bradypnea (hypopnea) means a decrease in the respiratory rate The rate may fall as low as 6 or 8 per minute An extremely slow respiratory rate is seen in patients with marked increased intracranial pressure because of depression of the respiratory center Drug narcosis and shock are commonly associated with a decrease in the respiratory rate because of their effects upon the respiratory center A slower rate occurs in lowered metabolism Kussmaul breathing is the slow and deep respiration found at times in profound diabetic coma before death (In the earlier stages of diabetic acidosis there is hyperpnea with a variable respiratory rate)

Apnea is the term applied to respiratory arrest It may be met with in periodic breathing to be described below

Dyspnea or labored breathing, is more than hyperpnea In addition to an increased depth of breathing, there is a subjective element in the air hunger which is unsatisfied Meakins defines it as follows 'Dyspnea is the consciousness of the necessity for increased respiratory effort' The student may recognize the subjective factor which he may have experienced at the end of a foot race, or upon mountain climbing at high altitudes The clinician soon learns to recognize dyspnea by the facies and attitude of the patient Dyspnea is seen most often in congestive heart failure and next in pulmonary disease due to obstruction in the respiratory tree, in asthma pulmonary edema, pleural effusion and in limited movement of the diaphragm and/or chest wall *Paroxysmal dyspnea* is air hunger which occurs periodically, the most frequent occasion being due to the pulmonary edema of left ventricular failure and is especially likely to occur at night (cardiac asthma)

Orthopnea Because of dyspnea in the supine position the upright position is assumed, and the condition is known as 'orthopnea The dyspnea may be so great in the recumbent or propped up position that the patient must sit erect in the hope of gaining relief The abdominal organs are lowered by gravity, thereby permitting freer play of the diaphragm than in the recumbent position Pulmonary congestion may be somewhat relieved in the upright position possibly by the retention of more blood in the splanchnic region Relief of pulmonary congestion permits greater expansion of the lungs The vital capacity is greater in the upright position

The commonest form of periodic breathing is the *Cheyne Stokes* type of respiration which is characteristic of advanced cardiac and renal disease and of increased intracranial pressure In general it indicates a poor prognosis It is characterized by a series of shallow slow inspirations which increase in rate and depth and then wane again until a period of apnea follows The cycle is repeated again and again (The student is referred to his physiology textbook for the anoxemic—carbon dioxide relationship involved)

Biot breathing is an irregularity of respiration Characteristically there are periods of apnea interspaced between periods of several shallow or deep inspirations the rate of the respirations also varying without any set pattern Though this occurs in normal sleep, it may be encountered in meningitis and in other intracranial disturbances

Grunting respiration is characterized by a grunt which is uncon

sciously produced by the patient at the end of expiration It is almost pathognomonic of lobar pneumonia

Stridulous breathing or *stridor* due to vibrations set up in partial obstruction of the respiratory tree whether in the larynx trachea or bronchi is typified by a harsh shrill whistling sound

Fig 11 Lipoma of back

Coughing is a mechanism provided in the body for the expulsion of substances secretions or foreign material from the respiratory tract (Inflammatory irritation as in dry tracheitis or bronchitis also induces cough) Secretions are carried by ciliary action of the mucosal cells and peristaltic movements of the bronchioles toward the larger bronchi and trachea where a cough impulse is initiated Irritation of the laryngeal mucosa acts in the same manner Cough may be induced reflexly also from the nerve endings in the pleura as in pleurisy The cough itself consists of a brief intake of air and a quick closure of the glottis followed by a forceful expiratory act.

Thus material is moved along the respiratory passages The act of coughing may be repeated a variable number of times to expel the substances from the respiratory tract

Hiccup (singultus) is recurrent spasm of the diaphragm It may be initiated reflexly from the abdominal organs or peritoneum or from the pleurae Thus peritonitis, pleuritis, or gastric distention com

Fig 12 Gummatous (syphilitic) osteitis of ribs One is indicated by arrow Second has broken down and drained granulating draining sinus is noted in infra axillary region

monly act as causes The distressing hiccup of uremia probably results from chemical stimulation of the respiratory center At times it is of psychogenic origin

Miscellaneous Observations Inspection of the chest is carried farther to note any abnormalities other than those discussed above They are numerous and obviously all cannot be enumerated

Scars should not be disregarded Those marking the drainage of empyema in former years may well explain the physical changes demonstrable due to an underlying thick pleura and fibrosed lung The scars of former sinuses have a related significance to antecedent pleural pulmonary or spinal disease The pathognomonic scars of the noduloulcerative syphilide in its favorite site on the back of the chest is as significant as a positive blood test The same is true of

Fig 13 Tuberculous osteochondritis of rib ■ evident as tumor below and medial to nipple

circular depressed scars over the sternum the signpost of past gummatous osteitis

Localized *swellings* or tumors are common On the back the most frequently encountered tumors are the circumscribed subcutaneous lipomas varying in size from 1 or 2 cm to those of 12 or 15 cm in diameter They may barely be elevated above the level of the skin or may project 6 cm above the level of the surrounding skin (Fig 11) At times they become immense and are pedunculated reaching such a size as to suggest a partially filled flour sack thrown over the shoulder Subcutaneous fibromas also are found at times as well as sebaceous cysts resulting from obstruction of the duct of a sebaceous gland The soft neurofibromas are likely to be found on the chest

wall especially (Fig 55, page 105) Inflammatory tumefactions of the soft tissue, other than the common staphylococcal furuncles or carbuncles of the upper back, are uncommon An occasional gumma, a dusky colored cold inflammation before it ruptures and drains a purulent and grumous material is seen less commonly now than in past decades These usually arise from the periosteum of the sternum or of the ribs (Fig 12) Similarly the cold inflammation of tuber culous disease originating from a rib or the pleura presents itself as a bluish red swelling as it points to drain with subsequent sinus formation (Fig 13) Rarely seen in modern medicine is *empyema necessitatis* in which an encapsulated empyema presents in an interspace causing localized swelling with redness and heat of the skin, followed by soften ing and finally rupture to drain the contents of the empyema cavity

Any rib may be the site of a local *tumor* due to a benign osteoma or chondroma generally these are not tender Bone sarcoma of the rib or more often, a metastatic tumor may cause expansion of the rib with a visible tumor which is tender upon palpation Gumma of the rib leads to a similar tumor (Fig 12) Pathologic fracture may occur with any of the malignant processes or with gumma Obvious irregularity of the bone should suggest such a lesion

Not uncommonly following therapeutic pneumothorax or in the presence of fractured ribs with pulmonary laceration air may leak from the pleural cavity into the subcutaneous tissues Then a localized swelling puffiness or infiltration of the skin appears to mask the anatomic landmarks, blotting out the costal elevations and the intercostal depressions and if it is widespread covering the clavicle and changing the contour of the neck (Fig 34)

Lastly upon inspection attention is given through the proper technic described in the preceding chapter to possible *pulsations* related to abnormalities of the cardiovascular system These will be covered more in detail in the chapter on cardiovascular disease Suf fice it to say that systolic pulsations may be visible in the infra clavicular and mammary regions and in the left interscapular region in the presence of aortic aneurysm In the interspaces posteriorly may be seen the pulsation of the dilated intercostal arteries taking part in the collateral arterial circulation necessary in coarctation of the aorta Such pulsation is most easily seen in the infrascapular areas

PALPATION

As was indicated under Inspection the fingers are used to amplify the observations made with respect to lag and to a decrease or absence of respiratory excursion

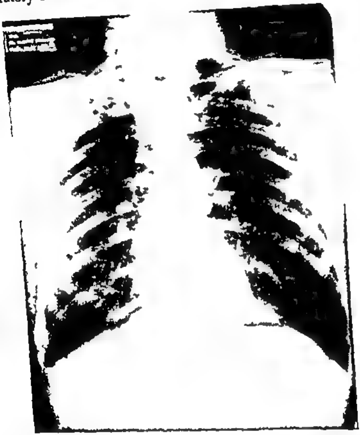

Fig 14 Pulmonary tuberculosis localized to right apex Fibroid reaction and pleural thickening have pulled trachea to right and reduced volume of upper lobe as shown by greater angulation of ribs and deceased radiolucency Left lung shows some compensatory emphysema as shown by widened inter costal spaces and increased radiolucency

The palpatory method of examination is used to verify suspected tracheal displacement in the suprasternal notch deviation may be either to or away from the side of disease Fibrosis of the lung or atelectasis may pull the trachea toward the affected side (Figs 14 15) owing to pleural fluid pneumothorax or unilateral emphysema the trachea may be pushed toward the unaffected side (Figs 16 18)

The palpating fingers may explore depressions, irregularities, or elevations in the chest contour, and thereby obtain more information than by means of inspection alone Thus the nodules of the rachitic rosary are found to be hard, calcified structures Likewise, the various tumors of the ribs are usually felt to be firm or hard and, in addition tender to touch Lipomas are firm but can be indented, and they have

Fig 15 Postoperative atelectasis of right lower lobe (relieved by aspiration of mucus) Trachea heart and other mediastinal structures are deviated to right Right upper lobe and left lung are emphysematous On left side inter spaces are widened and diaphragm is depressed

a lobulated feel The physician should always note the mobility of any tumor and the presence or absence of fixation to underlying or over lying tissue Inflammatory swelling though firm at first usually softens as it breaks down before spontaneous rupture usually it is tender At the line of fracture of a rib pathologic or traumatic, the examiner will find tenderness and usually crepitus—a grating sensa

tion as the opposing broken ends rub over each other either on respiration or when the examiner moves the rib by pressure If air has escaped into the subcutaneous tissue along the needle track in therapeutic pneumothorax or following pleural laceration, a peculiar crackling sensation (like the crumpling of cellophane) is felt as the palpating fingers press or roll over the affected area This is known as subcutaneous emphysema (Fig 34)

Fig 16 Spontaneous total pneumothorax of left side under pressure Mediastinal contents are displaced to right completely collapsed left lung projects as radiopaque knob at left border of mediastinum (From author's medical service Charity Hospital New Orleans)

Tenderness increased tone and even spasm may be readily demonstrated at times in muscles overlying active inflammatory disease This is encountered at its best in such a muscular reaction of the trapezius and pectoral muscles in instances of apical tuberculosis It is demonstrable in the serratus and intercostal muscles in the presence of pleurisy and pneumonia Conversely subsequent to the healing of long standing pleural and pulmonary inflammation notably tuberculosis atrophy of the overlying muscles and subcutaneous tissues is demonstrable upon palpation (This was noted also under Inspection page 357)

As the exploring fingers press on tissues in areas in which the *patient* complains of pain, tenderness may be elicited In the inter costal spaces one may find tenderness overlying areas of acute pleuritis The same may be found along the intercostal nerve involved in neuritis due to compression fracture of vertebrae or to the radiculi

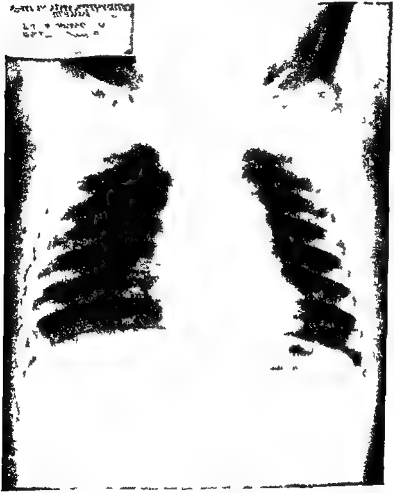

Fig 17 Inspiratory phase in child having foreign body which acts as ball valve in left major bronchus Mediastinum is in *midline*

tis of spinal arthritis as well as in herpes zoster In pleurisy of the basal *surface of the lung tenderness may* also be present over the segmental intercostal nerves, which provide the sensory supply to the lateral portions of the diaphragm

By *testing for sensitivity of the skin* with the pin point, one may

demonstrate hyperesthesia or hypesthesia in the anatomic area supplied by one or more segmental nerves

The palpating fingers are useful too in further analyzing visible pulsations for their extent and location If none is visible the examiner may search for pulsation to aid in diagnosis as in suspected

Fig 18 (Same patient as in Fig 17) Expiratory phase Left lung is emphysematous as shown by widened interspaces depressed diaphragm increased radiolucency and displacement of mediastinal contents to unaffected side

coarctation of the aorta aneurysm and the like (The description of the *thrill* is better considered in the chapters on the cardiovascular system) With respect to aneurysm of the thoracic aorta a specific palpating maneuver has been useful to me numerous times A sacsay of the descending thoracic arch may be from 8 to 12 cm in diameter and yet not be pressing upon the chest wall sufficiently to

produce either a visible or palpable pulsation Nevertheless, it is an expansile tumor If the patient is not too large or too obese and does not have a barrel chest, the expansibility may be demonstrated by bimanual palpation The patient, in a sitting position, is asked to

Fig 19 Lobar pneumonia with complete consolidation of upper lobe and apex of lower lobe Increased volume is shown by rib and interspace markings Fibrinous exudate the source of friction fremitus and rub is present on surface (Interlobar exudate marks with white line sulcus betwen upper and middle lobes)

hold his breath in full expiration, thereby reducing the chest diameter Then the examiner places the palms of his hands flat on the chest wall, one in front and one in back always opposite each other They are moved about over the suspected area If the expansile pulsation

of the intrathoracic sac is sufficiently great and when it lies in the area between the two hands the observer feels a definite sensation of expansibility his hands moving away from each other

Fremitus In addition to vocal fremitus as described in the pre

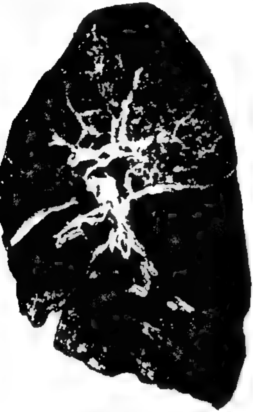

Fig [illegible] (Same patient as in Fig. 19) Longitudinal section shows airless upper lobe and apex of lower lobe illustrating reason for dulness upon percussion *Bronchi traversing consolidation are source of increased tactile fremitus* bronchial breath sounds and increased voice sounds unmodified by air-containing tissue (Middle lobe below white line of interlobar fibrin at left as well as most of lower lobe is resilient owing to its air content)

ceding chapter palpable vibrations may be set up within the chest because of disease A cough may produce a palpable vibration and is spoken of as *tussive fremitus* A rhonchus or bronchial rale when felt is described as *rhonchal fremitus* This type of fremitus is com

monly felt in bronchitis or in asthma as air passes through or over viscid secretion in a bronchus The palpating fingers feel a sensation *somewhat like that felt on the neck of a purring cat* *Rhonchal* fremitus can be proved to be such by noting its disappearance or

Fig 21 (Same case as in Figs 19 20) X ray film demonstrates consolidation of right upper lobe

alteration upon having the patient cough thus changing the position or tension of the secretion This type of fremitus is unattended by pain and is uninfluenced by pressure

Friction fremitus represents a palpable friction rub as felt in dry pleurisy, in which inflamed and fibrin covered visceral and parietal pleurae rub over each other during the respiratory excursion (Fig 19) This type of fremitus is encountered at its best in the lower

axilla or anteriorly over the mammary area since as was indicated in the last chapter these areas are the ones of greatest pulmonary excursion It is commonly encountered at the base posteriorly as well The grating sensation is felt best during inspiration It is

Fig 2 Tuberculosis of left lung Numerous tub r es are present in places confluent (bronchopneumonia) Areas of consolidation at expen e of some air-containing tissue explains increa ed tactile fremitus bronchovesicular breath sounds and increased spoken and whisp ed voice sounds Crepitant and sub crepitant rales are due to exudate in alveoli and bronchioles and smaller bronchi respectively

differentiated from rhonchal fremitus in that it is uninfluenced by cough it is intensified by pressure and pain accompanies the friction

The normal variations of *tactile fremitus* were discussed in the previous chapter At this point variations related to disease are considered

By comparing similar areas on the two sides of the chest differences in fremitus may appear which, interpreted along with other physical findings of the chest examination, are helpful in the diagnosis of pulmonary disease

Fig 23 (Same case as in Fig 22) X ray film shows shadows of consolidation decreased air content as shown by narrowed interspaces—left chest expanded less on inspiration

Increased Tactile Fremitus Vibrations are more readily transmitted by solid tissue Therefore any process which decreases the amount of air in the tissues and thereby produces a more solid medium will intensify tactile fremitus The degree of intensity depends upon the proportion of solid to air containing tissues Thus the consolidation of lobar pneumonia leads to the most intense degrees of tactile fremitus (Figs 20 21) Lesser degrees of intensity though still greater than

normal are found in lung infarct tuberculosis bronchopneumonia pulmonary fibrosis and in the presence of a solid tumor between the bronchus and chest wall (Figs 22–25) It also is somewhat intensified in the compressed lung adjacent to a tumor or just above the

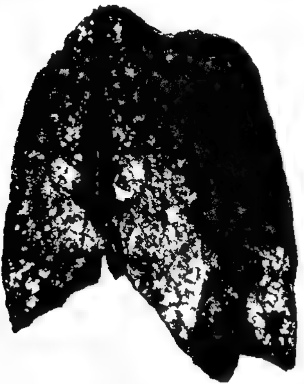

Fig 24 Alveolar structure of left lower lobe is replaced almost completely by dilated bronchi much fibrosis and bronchiectatic abscesses Therefore lower chest will move less on respiration Increased tactile fremitus dull percussion note bronchovesicular to bronchial breathing and increased voice sounds are to be explained upon solid tissue present at expense of air-containing lung Subcrepitant and bubbling rales result from exudate in smaller and larger bronchi respectively

level of pleural fluid Air under tension may also increase tactile fremitus This is encountered over large pulmonary cavities with tense walls and at times in compensatory emphysema Cavitation usually has a zone of surrounding pulmonary infiltration which ampli

fies the effect of the cavity walls acting as a resonator (Figs 26, 27)

Decreased Tactile Fremitus Naturally, laryngeal paralysis prevents the setting up of vibrations through phonation Bronchial obstruction caused by extrinsic pressure, such as that due to an aneurysmal sac or other mediastinal tumor may prevent adequate transmission of the

Fig 25 (Same case as in Fig 24) X ray film shows bilateral loss of aerated tissue in lower lobes Left costophrenic sulcus is obliterated by airless tissue and thickened pleura

vibrations downward to the lung and chest wall (Fig 2) In emphysema and attendant loss of pulmonary elasticity the alveolar walls do not transmit the vibrations as well as normally Decreased fremitus may be due to disease in the pleura which diffuses or reflects the vibration Thus thickening of the pleura or fluid or air in the pleural cavity may have such an effect (Figs 28, 29)

There may be complete absence of tactile fremitus in severe grades of the foregoing conditions. Therefore with massive accumulations of fluid in the pleural space the fremitus may not be demonstrable. This may be true likewise in the large pneumothorax (Fig 16)

Fig 26 Photograph of left lower lobe only showing tuberculosis with cavitation at its apex. Dull percussion note might have amphoric quality because of cavitation in consolidated area. Increased vocal fremitus and bronchovesicular and cavernous breath sounds are explained on consolidation and cavitation. Crepitant, sub crepitant and bubbling rales are to be expected

With total occlusion of a bronchus in massive atelectasis or pulmonary collapse tactile fremitus will be absent (Fig 15)

The *succussion splash* is the wave set up by the sudden movement of fluid in the pleural cavity. This occurs only in hydropneumothorax,

that is, in the presence of both air and fluid in the pleural cavity so that the chest is analogous to a jug half filled with water (Fig 30) As the jug is shaken, a wave is set up which breaks on the jug wall and can be felt The patient sitting on a chair or table is suddenly

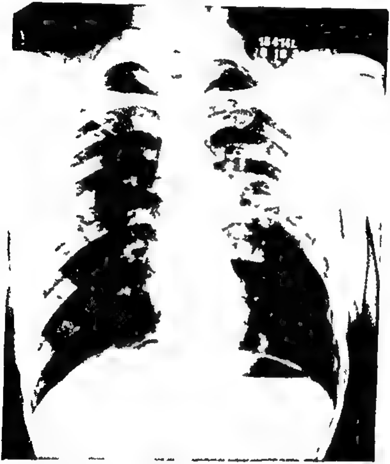

Fig 27 (Same case as in Fig 26) X ray film shows left chest to be smaller than right Cavity is seen lateral to hilar shadows on left

moved back and forth by the observer who has placed his hands on opposite sides of the chest The sensation of the wave breaking against the chest wall is easily felt by the examiner s hands

Percussion

The application of this method of examination to the interpretation of changes within the chest is simple If the principles detailed in the last chapter are remembered and applied, percussion will often be

found to provide significant information It may be of the utmost importance in the office or home where x ray examination is not available or as an aid in differentiating clinical possibilities suggested by shadows on the x ray film

Fig 28 Great thickening of right pleura with areas of calcification (probably due to missed empyema years before) Right chest is smaller because of this and pulmonary fibrosis (From author's medical service Charity Hospital New Orleans)

An essential to the proper interpretation of percussion findings is an adequate knowledge of anatomic relationships so that the observer may relate his percussion findings topographically to underlying organs Thus he must know not only the borders of the lungs as was indicated in the discussion of the normal but also the topography of the lobes Having these anatomic facts in mind the examiner may say that the percussion findings indicate consolidation of the upper or of

the lower lobe and of the middle lobe on the right (Figs 19–21 31, 32)

The student must remember the sites as described for resonance, impaired resonance, relative dulness and absolute dulness in the normal person *Any deviation from this pattern indicates some altera*

Fig 29 Pleural fluid filling costophrenic angle posteriorly Fluid level is delimited by concave line several interspaces above curved dome of diaphragm Anteriorly fluid is demarcated by interlobar pleura

tion in the normal relationship of air contained in the lung to the solid tissue Hyperresonance or tympany is indicative of more air than normal, decreased resonance or dulness or flatness indicates less than normal or complete absence of air Having these facts in mind the student should interpret on the basis of his knowledge of pathology the changes which have taken place within the chest cavity

Increased Resonance *Hyperresonance* may be localized or general Above the level of *compressed lung* as in pleural effusion there may be localized emphysema giving rise to a hyperresonant note * If one lobe is involved in a consolidating process or is col

Fig 30 Hydropneumothorax Vertical border of partially collapsed right lung demarcates it from air space Arrow indicates fluid level characteristically horizontal in the presence of air

lapsed the other lobe on that side may be somewhat overexpanded (compensatory emphysema) thereby showing hyperresonance (Fig 15) The same applies to collapse or consolidation of one whole lung and a compensatory emphysema of the opposite lung (Fig 18)

* The hyperresonance may have a tympanitic quality described by Skoda a century ago and known as *skodaic resonance*

Because of scoliosis of the spine the hemithorax on the side of the convexity of the spine will be somewhat larger than the other The lung on this side is mildly emphysematous in moderate degrees of deformity or there may be marked emphysema if the deformity is great

Fig 31 Lateral x ray view of right upper lobe pneumonia to illustrate its topographic anatomy as outlined by percussion (Arrow indicates sulcus between consolidated upper and aerated middle lobes)

(Fig 7) This may be demonstrated by the attendant hyperresonant percussion changes Hyperresonance is generalized over both lung fields in the senile emphysema of the aged and in the hypertrophic emphysema of asthma (Fig 9) (This hyperresonance has a box like note somewhat resembling a sound due to tapping a cardboard

box) Under these circumstances the expanded anterior lappet of the left lung overlying the heart offers such resonance that the *heart dulness* is obscured In generalized pulmonary emphysema the diaphragm is depressed so that *relative liver dulness* may not be demon

Fig 32 Lateral x ray view of right middle lobe pneumonia [illegible] illustrate its topographic anatomy as outlined by percussion (Arrow indicates sulcus between consolidated middle and aerated lower lobes) (See also Figs 5–12 pages 291 298)

strable or is decreased the lower border of resonance of the lung is depressed and little movement of the diaphragm may be shown by percussion In slight to moderate degrees of pneumothorax hyper resonance will be demonstrable on percussion (Fig 30)

Tympany in the normal subject is heard only over the lower chest on the left side owing to the presence of air in the stomach (Fig 27 page 322) Because of air swallowing or after meals the higher level of the gas bubble may account for tympany as high as the fourth rib anteriorly, as well as in the axilla This may interfere with percussion of the outline of the heart In large accumulations of air in the pleural cavity (pneumothorax), the note may be tympanitic, especially if the intrapleural pressure is high (Fig 16) A tympanitic note which is localized is usually indicative of cavitation in the lung (At times, especially in tuberculosis, a pneumothorax may be localized to a portion of the pleural cavity because of adhesions, and thus may account for local tympany This may be difficult to differentiate from cavity within the lung)

The tympany heard on percussion over cavities varies among patients and from time to time in the same patient These differences and changes are related to the distance of the cavity from the periphery of the lung, that is, intervening consolidation or vesicular tissue will modify the tympanitic note (Figs 26 27) The presence of, or absence of fluid in a cavity will alter the percussion note, since the amount of air varies with this The tenseness or relaxation of the cavity wall will modify the note—the more tense the wall the more tympanitic and musical the sound because of overtones The free access or not of air to the cavity through the bronchi will alter the note in a manner similar to the percussion note over the cheek with mouth open or closed as described in the preceding chapter *

Decreased Resonance The range of changes of the percussion note from resonance through dulness to flatness is great, and thus many degrees of variation in the note may be recognized

Within the Lung Modification of resonance results from an encroachment upon the normal air containing tissue of the lung Very slight inflammatory infiltration of lung tissue, as in minimal tuberculosis may give rise to slight impairment recognizable only to the ex

* Changes of note under certain circumstances in the presence of cavitation were described in the past by Wintrich Gerhardt Friedreich and Biermer Their names were attached to these signs These signs were supposed to be of great importance in physical diagnosis of the past They have no practical significance but are of historical interest If the physician by his findings suspects cavity x ray examination is in order

perienced clinician because of the minor changes in sound In the left infraclavicular region this may be comparable to the normal minor impairment on the right as described in the last chapter With more extensive infiltration the note will become more definitely impaired recognizable even by the novice (Fig 14) The impairment may be generalized bilaterally in bronchopneumonia or in pulmonary edema (Figs 22 23) Because of chronic changes in the lung or in a lobe from diffuse fibrosis or from the lobar fibrosis commonly associated with bronchiectasis the air containing tissue is reduced by the overproduction of fibrous tissue and impairment of the percussion note will result (Figs 24 25)

Thus it is seen that lesser degrees of infiltration produce impairment of resonance upon percussion (Figs 14 22–25) Under other circumstances the air containing tissue may become consolidated When this occurs the note may vary from moderate impairment to the dulness found normally over the liver For example the hepatization of lobar pneumonia is characterized by a dull percussion note (Figs 19–21) The areas illustrated in Figs 22 and 23 probably showed an impaired note short of dulness because of some air containing tissues Dulness of the right middle lobe and/or of the right lower lobe will blend with hepatic dulness relative dulness being lost as the lung filling the costophrenic sulcus becomes consolidated (Fig 32) Dulness of the left upper lobe or of the lower lobe will blend with the cardiac dulness in the regions where the lung overlies the heart Posteriorly dulness of either lower lobe blends with the dulness normally present below the tenth rib A new growth in the lung may replace air containing tissue as effectively as an inflammatory process and will give rise to the same degree of dulness

Outside the Lung Changes in the pleura or in the pleural space will give rise to changes in the percussion note because the vibrations set up in the air containing lung cannot be freely transmitted to the thoracic cage

Pleural thickening in acute or chronic inflammation especially the latter will modify the resonant note produced in the underlying lung resulting in impairment Only occasionally will the pleura be so thickened as to produce a dull note This may be seen at times fol

lowing chronic empyema, in which the pleura may become very thick and even calcified (Fig 28)

Fluid accumulated in the pleural space resulting from cardiac failure, inflammation, new growth bleeding or rarely due to chyle will give rise to changes ranging from impairment through dulness to flatness (Figs 29, 30) It is estimated that at least 500 cc of fluid

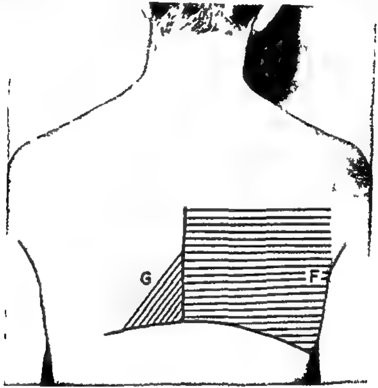

Fig 33 Grocco s triangle (*G*) flatness (*F*) due to large amount of fluid in right pleural cavity

must be present in the adult before percussion changes can be demon strated Large accumulations of fluid give rise to a flatness unusually encountered with consolidation

Fluid in the pleural cavity does not assume a horizontal level as might be expected The fluid, except when it almost completely fills the cavity has a higher level of dulness posteriorly and swings down ward in the axilla A greater accumulation of fluid in the deeper posterior costophrenic sulcus explains the higher percussion level posteriorly where there is in addition less excursion of the lung (Fig

29) If the patient lies on his side for a time the fluid will gravitate to the axilla

If the accumulation of fluid is great a triangular area of dulness will be found on the unaffected side posteriorly probably owing to transmission of dulness in the spinal structures This triangle is a right angle triangle the vertical side being in the midspinal line the hypotenuse extending down to the tenth rib (this is known as Grocco s triangle) (Fig 33)

In the presence of thickened pleura or in small accumulations of fluid the costophrenic sulcus will become obliterated or filled with fluid Therefore the examiner will be unable to demonstrate descent of the diaphragm by percussion This may be a valuable sign of pleural disease (Fig 25)

It is worthy of comment again that not only is the percussion note altered in impaired resonance dulness and flatness but also the sense of resistance is notably altered The student will soon learn that the feel is different over the varying degrees of consolidation or fluid accumulation (He may practice and become familiar with this by percussing his own resonant chest the area of liver dulness and his thigh)

As was indicated earlier the coin test has its application in pneumothorax in which a ringing sound is produced

Percussion Changes Unrelated to Pleuropulmonary Disease Percussion of the chest may provide indications of disease or abnormalities not related to the pulmonary structures themselves Thus percussion of the upper sternal region may reveal impairment or dulness due to disease in the upper mediastinum Retrosternal extension from the thyroid gland enlargement of mediastinal lymph nodes and aortic aneurysm may be causes of dulness over the manubrium as well as parasternal dulness in the first second and third interspaces of either or both sides

Evidence of the presence of retrosternal *extension* of thyroid tissue may be gained by testing for a *tracheal tone* change The patient is asked to hold the bell of the stethoscope near the lips of the open mouth while the examiner percusses over the upper sternum Enlargement of the thyroid gland providing a solid medium between the trachea and sternum permits the transmission of a tone which nor

mally is produced only by direct percussion of the trachea in the supra sternal notch (Obviously any solid structure such as enlarged mediastinal lymph nodes would give the same findings)

"Ewart s sign' is the name applied to the percussion dulness demonstrable at the region of the angle of the left scapula in instances of pericarditis with large effusion The compression of the left lower lobe by the distended pericardial sac accounts for the changed note (Chapman and Anderson have shown that impairment or dulness at the left base may result also from enlargement of certain chambers of the heart thereby compressing the lung The auscultatory signs of pulmonary infiltration or consolidation may accompany the change in percussion note)

AUSCULTATION

Breath Sounds Modification of the normal breath sounds, as described in the preceding chapter, are of great importance in the evaluation of disease within the chest The student should make every effort to interpret these changes, as well as those found on palpation and percussion in terms of disease as encountered at necropsy and at surgical operations He should also correlate them with the shadows seen in the x ray film

If changes within the chest are such that breath sounds are not transmitted as well because of alterations in the elasticity of structures within the chest or in the chest wall itself breath sounds may be de creased in intensity Or if something is interposed to prevent the transmission of vibrations within the lung to the chest wall breath sounds will be decreased or absent On the other hand solid structures transmit vibrations set up in the tracheobronchial tree better than the normal lung Thus dense tissue or structures which have developed at the expense of air containing tissues enhance the respiratory sounds set up in the bronchial system

Decreased or Absent Breath Sounds Changes in breath sounds vary in degree dependent upon the extent of pathologic alteration Thus under most of the conditions to be discussed there may be either a decrease in the sounds of varying degree or complete absence of breath sounds Obviously if air currents are not induced which are of the required intensity to set the respiratory tree into vibration, the

breath sounds will be decreased Therefore, pain referred to the chest of pleural or peritoneal origin may cause such reflex splinting of the muscles of the chest wall or of the diaphragm as to reduce greatly the respiratory excursion As a result breath sounds are decreased in intensity and appear to be distant (Fig 33 page 336) Similarly paralysis of muscles of the thoracic cage as in hemiplegia or anterior poliomyelitis will have the same effect often causing complete absence of breath sounds

WITHIN THE LUNG Several changes within the lung itself may cause a decrease or absence of breath sounds Obstruction to a bronchus by tumor foreign body tenacious secretion or inflammatory stenosis will reduce or prevent the air from reaching the air sacs to dilate the alveoli and may reduce or eliminate vibrations being set up in the bronchi (Figs 15 18) Emphysema decreases breath sounds for several reasons Elasticity of the lung is lost and thus transmission of bronchial vibrations is reduced and those sounds which reach the periphery are dampened by diffusion and reflection in the distended air sacs and alveoli In addition the increased residual air which remains in the distended alveoli and the decreased tidal air of the emphysematous lung permit little further distention of the alveoli thereby decreasing the vesicular element in the breath sounds The breath sounds are therefore diminished in intensity Because of the loss of elastic recoil in the emphysematous lung breath sounds are further changed by an increase in the expiratory phase of the vesicular breathing Contraction of the internal intercostal muscles accounts for the active element in the expiratory phase replacing the normal passive phase Breath sounds may also be decreased in pulmonary congestion because of edema of the alveolar walls which permits less expansibility of the air spaces (See Fig 33 page 336 regarding distant or decreased breath sounds)

OUTSIDE THE LUNG Factors outside the lung may operate in decreasing breath sounds or eliminating them entirely They are related to the pleura An acutely inflamed pleura is thickened and may be covered by a fibrin deposit this as well as the decreased respiratory excursion which results from pain leads to a decrease of the breath sounds Chronic thickening of the pleura has the same effect (Fig 28) Effusion of serous sanguineous or inflammatory fluid in the

pleural cavity may cause a decrease of breath sounds or their complete absence depending upon the amount of fluid interposed between the parietal and visceral pleurae (Fig 29) Fluid effectively decreases sound by diffusion and absorption Pneumothorax also may result in a decrease or absence of breath sounds depending as in the case of fluid upon the amount of air separating the two leaves of the pleura (Figs 16 30)

Bronchial and *Bronchovesicular Breath Sounds* With the introduction of the tubular or blowing quality into the sounds breath sounds become higher pitched louder and harsher In its lesser degree, the sound is described as bronchovesicular in its greater degree it is clearly defined as a bronchial sound (Fig 33 page 336) Such changes indicate a decrease in the air containing tissue and an increase of airless tissue which more readily transmits to the chest wall the vibrations which are set up in the bronchi These sounds are modified to a lesser extent than normally by alveolar tissue The change to bronchovesicular or bronchial breathing is encountered most often in inflammatory consolidation of acute pneumonitis (various types of pneumonia) or in chronic pneumonitis (most often tuberculosis) (Figs 19—27) Pulmonary fibrosis at the expense of alveolar tissue permits by its fibrous strands and septums improved transmission of bronchial sounds to the periphery (Fig 14) Solid tumors between the bronchi and the periphery of the lung transmit bronchial sounds without vesicular modification As was noted in association with Ewart s sign (page 382) the breath sounds may be bronchial as the result of pulmonary compression by an enlarged heart or large pericardial effusion

Altered Breath Sounds The breath sounds may be altered by the presence of cavities in the lung (Figs 26 27) *Cavernous breathing* is a low pitched blowing sound having a hollow quality supposedly due to air entering a cavity with relaxed walls (The student can simulate it by blowing with the open mouth into his cupped hands) *Amphoric breathing* is a high pitched hollow sound presumed to be due to air entering a cavity with tense resonating walls This quality may be imparted to the breath sounds in a tension pneumothorax (The sound is similar to that produced by blowing over the mouth of a jug or bottle)

Cogwheel breathing is a term applied to the circumstance under which the inspiratory phase of the breath sounds is broken by two or three pauses supposedly due to several bronchioles opening individually at various times in a small diseased area (Fig 33 page 336) *Metamorphosing breathing* is a type in which the inspiratory phase begins as low pitched vesicular sound and suddenly changes to a higher pitched bronchial sound It may be due to an occluded bronchus opening abruptly In hydropneumothorax with a bronchopleural fistula a ringing sound the so-called *metallic tinkle* may be produced as air escapes from the fistula through the fluid

Voice Sounds The spoken and whispered voice sounds are modified by disease in a fashion similar to that of the breath sounds Since the same fundamentals of physics are involved this need hardly be discussed in detail The sounds will be diminished for the same reasons and by the circumstances enumerated under Decreased Breath Sounds Increase in solid tissue in the lung accentuates the spoken and whispered voice sounds (Figs 14 19–27)

The spoken sound or vocal resonance not only may be intensified by a consolidating process in the lung but may be changed also in quality The spoken voice may be recognized as articulation rather than the blurred sound of the normal state This characteristic is described as *bronchophony* (Figs 19 20) If the recognition of the pronunciation is still more distinct and intense it is described as *pectoriloquy* * If the spoken word is heard with a nasal quality to the sound it is described as *egophony* The latter is heard in the lung adjacent to consolidation or compression by fluid

Though changes in the spoken voice are of relatively minor diagnostic importance intensification of the whispered voice may be of major importance The term *whispered pectoriloquy* is applied to the transmission of articulate whispered voice sounds This or simply an intensified whispered sound is often recognized over such minimal pulmonary infiltrations that neither changes in the percussion note nor breath sounds are recognized If the student will remember the sparse

* D Espine s sign Normally p ctoriloquy may be heard over the spine to the level of the tracheal bifurcation In infants it is heard at the level of the seventh cervical vertebra Pectoriloquy heard at lower levels than this has been thought to suggest enlargement of the bronchial lymph nod s The value of this sign is open to great question

localization of whispered voice sounds, as noted in the previous chapter, he will find the whispered voice to be a *most important* physical sign at times in finding minimal tuberculous infiltrations

Adventitious Sounds The metallic sound (*coin test*) of bell like quality was described under Percussion as heard in the presence of

Fig 34 Subcutaneous emphysema Arrows indicate air in subcutaneous tissue Note resultant mottling in shadow of right chest not seen on left

pneumothorax Just as the *succussion splash* may be felt upon shaking the patient who has a hydropneumothorax it may be heard also if the stethoscope bell is held against the chest wall above the line of fluid

Friction Rub The palpable rub of fibrinous pleurisy was described under Palpation The sound produced by the movement of the inflamed visceral and parietal pleurae over each other may be quite characteristic (Fig 19) This may be of a rough grating or scraping character or less commonly be creaking like the sound produced on bending sole leather In any case it is heard at its best during inspiration and gives the impression of being close to the ear Pressure of the stethoscope bell over the area of friction may intensify the sound unless the patient is obese These points are important in the differentiation of a friction rub from crepitant rales *This error in differentiation* has been made at some time by every physician It should also be recalled that the friction rub will most often be heard over the areas representing the greatest pulmonary excursion that is over the front and the lower axillary areas of the chest

Subcutaneous emphysema may be encountered in cases of therapeutic pneumothorax or in cases of fractured rib with pleural laceration (Fig 34) A remarkable crackling is heard which may simulate crepitant rales However the student will note at once that the sound has no clear cut relationship to the respiratory cycle and that tilting the stethoscope bell back and forth on the chest wall produces the sound proving its origin to be outside the chest cavity

Rales Certain adventitious sounds are set up within the diseased lung which are never heard in the normal person except as described in the foregoing chapter under Marginal or Atelectatic Rales

Rales are due to exudate somewhere in the respiratory tree This may be in the tracheobronchial tree or in the air sacs and alveoli The site of the exudate can be recognized by the type of rale heard Laennec described rales more than a century ago He termed them either *dry* or *moist*

DRY OR MUSICAL RALES These musical sounds are due to tenacious exudate which partially occludes a bronchus or bronchiole Such mucus stretched across the lumen of a bronchus may be thrown into vibration like a reed in a wood instrument The tension of the mucus or other physical circumstances may be so changed by having the patient cough that the rales disappear especially if they are few and if they are due to exudate in larger bronchi Musically dry rales are described as *sibilant* if of a high pitched whistling variety or *sono*

rous, if of a low pitched groaning or snoring type Dry rales are heard at their best in bronchial asthma in which a multitude of musical squeaking sounds are heard because of the widespread mucoid exudate in the bronchial tree * They may be more prominent during the prolonged expiration (Fig 33 page 336)

The remainder of the rales are not musical, and since they suggest air moving into or through a more liquid type of exudate, they are sometimes classified as moist

GURGLING RALES are large loud gurgles heard without a stethoscope due to liquid exudate in the trachea and major bronchi They are heard often at a distance from the patient in the death rattle, in deep coma, or under anesthesia because of the loss of the cough reflex

BUBBLING RALES are similar to gurgling rales low pitched and less loud and heard with the stethoscope They are caused by liquid exudate in the larger bronchi Such rales are much like the sound produced by blowing through a straw in a partially filled bottle of soda pop

CREPITANT RALES (fine moist rales) are at the opposite extreme by contrast They are heard as a high pitched crackling sound at the end of inspiration and probably represent the sound produced as air enters and separates the alveolar walls which had been stuck together by exudate (Figs 22 23) (The sound is similar to that which is produced by gently separating two sheets of fly paper Cabot suggests that the student can simulate the sound of these rales by rolling scalp hair between the fingers just above the ear) Crepitant rales must be differentiated by the beginner from a pleural friction rub and from the stethoscope bell rubbing on the hair of the chest

SUBCREPITANT RALES are of a higher pitch than bubbling rales and are not nearly so large or loud On the other hand they are not fine and crackling having definitely a more liquid character and are of a lower pitch than the crepitant rale These are very important in inflammatory disease and represent the presence of liquid exudate in the bronchioles and smaller divisions of the bronchi (Figs 22–25)

Since air may not be entering a region in which inflammation is present, rales may not be heard A maneuver may be used which

* The term music box chest was used in the past to describe the exaggerated number and variety of musical rales heard during an asthmatic attack

may help to demonstrate such exudate and this method is especially worthy of trial in suspected early tuberculosis The patient is asked to breathe with his mouth open At the end of passive *expiration* he is instructed to give a slight cough * The increased intrapulmonic pressure distends the bronchioles and alveoli and if the latter were atelectatic due to exudate they are now patent, and on the following respiratory cycle crepitant rales may be heard These are called *post tussic rales* (If this is continued sufficiently long the exudate may drain out of the region and then the rales are lost Every instructor has experienced this as he tries to demonstrate rales he has heard to several students)

DISEASES OF THE CHEST

I have emphasized that the student should interpret physical findings in terms of the knowledge gained in his study of pathology at the autopsy table If he will keep in mind what has gone before in this chapter he may be able to visualize the pathologic changes which would account for the deviation of chest findings from the normal

In a consideration of the chest diseases to be described below a definite pattern will be followed A brief resume of the pathologic findings will be given stressing certain points so that the student may understand the physical findings which will be enumerated subsequently In some instances examples of typical x ray findings will accompany the description to aid the student in interpretation of the signs described Let it be remembered that most of the conditions to be described can be diagnosed by history and physical examination as well as by the x ray film The latter may be essential in diagnosing suspected lesions which are small it is most helpful in measuring the extent of the pathologic change and in the prognostic evaluation of disease correctly diagnosed by history and examination

Only clear-cut diseases will be described in this book The detailed variations complications and atypical examples will be left to text books of medicine and medical diagnosis The purpose of this section of the text is to illustrate for the student how physical diagnosis may be applied

* Spontaneous cough is preceded by a short inspiration following which the glottis closes and then a forceful expiration is initiated. This force against a closed glottis raises the intrapulmonic pressure to quite a degree

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Inflammatory Diseases of the Lung and Pleura

Acute Bronchitis An acute infection of the bronchi having associated constitutional symptoms and characterized by cough eventually productive of mucoid sputum

Pathology Redness and swelling of the tracheobronchial mucosa covered by tenacious mucous exudate, at times purulent

Chronic Bronchitis A chronic inflammation of the tracheobronchial tree, accompanied by a cough productive of variable amounts of purulent sputum, and at times by bronchial spasm

Pathology Inflammation with atrophy, hypertrophy, or hyperplasia of the tracheobronchial mucosa and with mucoid purulent exudate, eventual development of variable degrees of pulmonary fibrosis and compensatory emphysema

Physical Signs INSPECTION Normal PALPATION Palpable rhonchi at times PERCUSSION Normal AUSCULTATION Commonly musical or dry rales and wheezes as well as subcrepitant rales

Remarks For physical signs dependent upon resultant pulmonary fibrosis or emphysema see these clinical entities as described below

Bronchiectasis A chronic infection, most often affecting the lower lobe bronchi, characterized by constitutional symptoms, and cough productive of profuse purulent often foul sputum

Pathology At first diffuse bronchial dilatation later, fusiform or saccular dilatations with stasis of secretions mucosal atrophy, ulceration of the bronchial walls leading to stenosis, at times, peribronchial abscess formation, interstitial inflammation with pulmonary fibrosis and pleural thickening, at times bronchopneumonic areas compensatory emphysema of the unaffected lobes (Figs 24 25)

Physical Signs In mild instances the same as in chronic bronchitis In severe cases INSPECTION Lag of and decreased expansion of the affected side flattening and retraction of the chest over the area of the lobe involved PALPATION Vocal fremitus increased over the affected lobe, if pleural thickening is not too great PERCUSSION Impairment to dulness over the diseased lobe, at times a tympanitic note over a large saccular bronchus near the pleura, a fixed diaphragm on the affected side, hyperresonance over the lobes showing compensatory emphysema AUSCULTATION Bronchovesicular to bronchial breath sounds over the area of the affected lobe, distant or faint if the pleura

is greatly thickened bubbling subcrepitant and crepitant rales varying from time to time cavernous breathing if a large saccular dilatation lies close to the periphery

Remarks Other characteristic findings foul breath clubbing of the fingers and toes and watch crystal nails

Bronchopneumonia An acute bacterial infection commonly with severe constitutional reaction blood tinged sputum later becoming purulent

Pathology A diffuse patchy (lobular) consolidation at times becoming confluent (lobar) bronchiolar inflammation and exudate with atelectasis of associated air spaces and emphysema of intervening areas a varying degree of fibrinous pleuritis (Figs 22 23)

Physical Signs INSPECTION Limited inspiratory movement PALPATION Variable dependent upon the proportion of consolidation and atelectasis to compensatory emphysema PERCUSSION Usually impairment of the note AUSCULTATION Diffuse crepitant and subcrepitant rales occasionally dry rales at times a pleural friction rub early the breath sounds are commonly suppressed or distant, later, with moderate consolidation they are bronchovesicular

Remarks Other findings tachypnea commonly cyanosis at times use of accessory muscles of respiration tachycardia If distribution of disease is lobar the signs are those of lobar pneumonia

Lobar Pneumonia Typically a pneumococcal infection of the lung associated with characteristic constitutional symptoms and clinical course

Pathology A massive inflammatory exudative consolidation of one or more lobes commonly one of the lower progression through consecutive courses of congestion red hepatization gray hepatization and resolution an accompanying acute bronchitis and fibrinous pleuritis followed frequently by some pleural fluid exudation (Figs 19–21 31 32)

Physical Signs Stage of Congestion INSPECTION Lag of and decreased expansion of the affected side the patient preferring to lie on that side PALPATION Normal PERCUSSION Slight impairment over the diseased lobe AUSCULTATION Vesicular breath sounds are distant or suppressed some hours after onset crepitant rales appear a pleural friction rub is heard frequently

Stage of Hepatization INSPECTION Little if any movement of the affected side, which may appear larger with filling out of the inter costal spaces PALPATION Probably a palpable pleural friction rub and tenderness of the chest wall, increased tactile fremitus PERCUSSION A dull note, at times almost flat AUSCULTATION Characteristically bronchial or tubular breath sounds with some crepitant and commonly musical rales, bronchophony and pectoriloquy a friction rub until fluid accumulates to separate the pleurae

Stage of Resolution INSPECTION Less limitation of chest movement PALPATION Tactile fremitus usually lessened PERCUSSION An impaired note dull if there is much pleural fluid AUSCULTATION Breath sounds diminished, many crepitant and subcrepitant rales over the affected lobe

Remarks Characteristically there appear early cyanosis, an expiratory grunt tachypnea use of the accessory muscles of respiration tachycardia and pain referred to the chest wall If lobar pneumonia begins centrally in the lower lobe, these signs may all be present with pain referred to the trapezius muscle and abdomen (due to diaphragmatic pleurisy) the signs of consolidation may be delayed for forty eight to seventy two hours until it reaches the periphery of the lobe (For brief periods the physical findings described above may be modified by obstruction of a bronchus by mucus)

Lung Abscess Usually a localized area of suppuration following (1) aspiration of infected material or a foreign body (2) an infected embolus (3) pneumonia (4) neoplasm or (5) at times without specific cause (idiopathic) accompanied by marked constitutional symptoms and profuse usually foul purulent sputum

Pathology Commonly in the lower lobes especially on the right, necrosis first followed by liquefaction and cavity formation In the early stages, the walls are ragged and necrotic later defined by dense fibrosis

Physical Signs INSPECTION Flattening of the chest and retraction commonly over the affected lobe with decreased inspiratory movement PALPATION Decreased fremitus if there is much pleural reaction, increased if much inflammatory infiltration is present about the abscess PERCUSSION Impairment to dulness, dependent upon the pleural reaction and inflammation about the cavity, tympany over the

cavity if at the periphery of the lung and if it contains air AUSCULTATION Breath sounds are commonly cavernous or amphoric, distant if the cavity is deep within the lung prominent at the periphery crepitant and subcrepitant rales commonly if active inflammation is present about the cavity spoken and whispered voice intensified

Remarks Clubbing of fingers and toes and incurvature of the nails are usually present if the abscess has existed for a long time though these changes may develop with remarkable rapidity

Tuberculosis Usually a chronic progressive pulmonary inflammation due to the tubercle bacillus leading to constitutional symptoms cough productive of sputum and often hemoptysis

Pathology The lesion begins as a localized area of exudation practically always in the upper lobe and progresses with exudation caseation and cavity formation accompanied usually by widespread pleural reaction and pulmonary fibrosis (Figs 14 22 23 26 27)

Physical Signs Minimal Stage Though commonly no physical abnormalities are demonstrated with progression signs may appear as follow INSPECTION Normal or a lag of the infraclavicular region on inspiration PALPATION Normal PERCUSSION Slight impairment of the infraclavicular upper axillary or the suprascapular areas AUSCULTATION Bronchovesicular breath sounds whispered voice sounds present or intensified crepitant rales at times brought out by an expiratory cough

Advanced Stages INSPECTION Trachea deviated to the side of fibrosis flattening retraction and decreased expansion of the chest over the affected areas or sides PALPATION Tactile fremitus often increased PERCUSSION Impairment to dulness over the affected lobes tympany over cavities at the lung periphery limitation of diaphragmatic descent due to pleural adhesions AUSCULTATION Breath sounds bronchovesicular some areas bronchial and over cavities cavernous or amphoric crepitant and subcrepitant rales whispered pectoriloquy and intense voice sounds at times bronchophony with a cavernous quality over cavities a pleural friction rub often

Remarks In advanced disease and in bilateral involvement all possible combinations of physical findings may occur over one or the other side of the chest At times a confluent process may give the signs of lobar consolidation In the aged the fibroid process may be

so marked that the findings may be those of fibrosis or emphysema as will appear below The signs of tuberculous laryngitis and tuberculous ulcers of the oropharynx and of the buccal cavity may appear in late disease Tuberculous tracheitis and bronchitis also are not unusual in the later stages

Pleurisy Commonly a painful inflammation of the pleura accompanying acute or chronic pulmonary inflammation (as appears above) or limited to the pleura itself, at times, a reaction to newgrowth primary or metastatic, invading the pleura, occasionally in uremia

Pathology 'Dry' pleurisy, typified by a fibrinous exudate, usually followed by 'wet pleurisy with exudation of fluid into the pleural space and terminating in pleural adhesions (Figs 19, 28, 29)

Physical Signs INSPECTION Decreased or absent movement of the affected side, increased size and bulging of the interspaces in massive accumulation of fluid, asymmetry, flattening, and retraction of the chest in pleural adhesion, tracheal deviation to the side opposite the accumulation of fluid or to the side of pleural adhesions and pulmonary fibrosis PALPATION A friction rub in the dry type, unless pain prevents sufficient movement of the chest, decreased to absent tactile fremitus with effusion, decreased fremitus with a thickened adherent pleura PERCUSSION Impairment in the dry state dulness to flatness with increasing accumulation of fluid, impairment to dulness and limitation of the diaphragmatic descent in symphasis pleurae cardiac displacement to side opposite the fluid AUSCULTATION A friction rub disappearing with the accumulation of fluid and reappearance with absorption of fluid decreased to absent breath sounds and voice sounds distant tubular breathing and whispered pectoriloquy dependent upon the amount of fluid present, distant or decreased breath sounds over a healed thickened pleura

Remarks The signs of noninflammatory fluid such as blood chyle and the serous effusion of congestive heart failure are the same except for the friction rub

NONINFLAMMATORY DISEASES OF THE LUNG AND PLEURA

Massive Atelectasis A collapse of one or more lobes of the lung due to (1) bronchial obstruction due to secretions (Fig 15) foreign

body tumor or inflammatory stenosis (2) compression as from elevation of the diaphragm tumor large heart or pleural fluid

Pathology A firm airless lobe or lobes with compensatory emphysema of the remainder of the lobes

Physical Signs INSPECTION A retracted chest with narrowed interspaces on the affected side and little if any movement, tracheal deviation to the affected side PALPATION Decreased or absent tactile fremitus over the affected area related to the degree of collapse PERCUSSION Impairment over the collapsed lobe if on the right dull posteriorly because of elevation of the liver with the diaphragm hyperresonance over the unaffected lobes cardiac displacement to the affected side AUSCULTATION Decreased or absent breath sounds depending upon the degree of atelectasis if present of a bronchial character rales present upon reexpansion of the lung

Remarks Other signs are tachypnea dyspnea cyanosis and tachycardia

Foreign Body Aspiration of organic or inorganic material into the tracheobronchial tree A foreign body may act as a ball valve alternately obstructing and opening a bronchus (Figs 17 18)

Pathology Depending upon its size occlusion of a bronchus with resultant atelectasis later bronchiectasis lung abscess or pulmonary fibrosis

Physical Signs INSPECTION In the event of tracheal obstruction retraction of the tissues at the base of the neck if of a major bronchus retraction of the interspaces and movement of the subcostal border toward midline on the affected side PALPATION At times a thud palpable by a finger on the trachea synchronous with movement of a *foreign body* in the trachea absent tactile fremitus in the presence of bronchial occlusion PERCUSSION Dulness over the collapsed lung in bronchial occlusion hyperresonance in rare instances of a foreign body acting as a check valve AUSCULTATION Wheezing at times decreased or absent breath sounds over the lobes with occluded bronchi

Remarks If bronchiectasis lung abscess or fibrosis supervenes the signs are as described under these conditions The same is true in massive collapse

Lung Tumor Most tumors are bronchogenic in origin The signs will not be described in detail If bronchial obstruction occurs, the signs may be those of atelectasis, though moderate degrees of obstruction accompanied by infection may lead to bronchiectasis If the tumor breaks down, lung abscess may be simulated Fibroid reaction may simulate a fibrosed lung If the tumor reaches the pleura it causes pain a friction rub and finally a bloody effusion

Emphysema A distention of the alveoli locally or generally, arising either as an acute or as a chronic state locally it is usually compensatory to a decreased air content in other lobes or other lung (Figs 9, 15, 18)

Pathology Voluminous pale lungs which do not collapse, often showing indentations from the ribs and the presence of bullas at the lung margins, dilated air sacs and alveoli decreased numerically a loss of elastic tissue and of many capillaries

Physical Signs INSPECTION A voluminous barrel chest appearing as if in a constant state of inspiration spinal kyphosis and round shoulders interspaces broad and often filled out PALPATION Tactile fremitus decreased PERCUSSION The note hyperresonant at times almost tympanitic, the lung bases low due to a depressed diaphragm with little or no excursion AUSCULTATION Breath sounds distant and feeble expiration being prolonged by an active expiratory effort frequently asthma often dry rales spoken voice poorly transmitted

Remarks Some of these characteristics *without* the enlarged chest were described in the normal as senile emphysema Other than the loss of pulmonary elasticity of age or of prolonged bronchial asthma emphysema most commonly results from the interstitial fibrosis which may follow either acute or chronic infections of the lung Unilateral emphysema of the lungs and fibrosis in its fellow may be found as the result of marked scoliosis Lobar or unilateral emphysema is compensatory in aiding to fill a chest in which lung volume has been lost Other signs in emphysema may be cyanosis and tachypnea

Bronchial Asthma Usually an acute diffuse bronchiolar obstruction, commonly due to an allergic cause and characterized by respiratory difficulty and cough productive of tenacious mucus at the termination of the attack

Pathology Edema of the bronchial mucosa with bronchospasm, and a sticky mucous exudate

Physical Signs INSPECTION A chest held in the position of inspiration and appearing of increased size prolonged active expiratory effort PALPATION Tactile fremitus decreased PERCUSSION A hyperresonant note AUSCULTATION Expiration longer than inspiration accompanied by a multitude of sibilant rales and a lesser number of crepitant rales

Remarks Moderate cyanosis may be present

Pulmonary Fibrosis A chronic fibroid reaction to inflammation in the lung or pleura as the result of infection, disease of the vascular bed tumor or dusts (pneumoconiosis) characterized by dyspnea cough and sputum (Figs 8 28)

Pathology Diffuse fibrosis with decreased alveolar tissue in some areas emphysematous tissue elsewhere distortion of bronchi with development of bronchiectasis, thickening of interlobular septums and of the pleurae

Physical Signs INSPECTION A chest usually flattened moving little on respiration retraction of the chest walls and the intercostal spaces a trachea often deviated to the more involved side PALPATION Tactile fremitus usually increased PERCUSSION Impairment except in areas of compensatory emphysema if such are present cardiac dulness may be displaced to the side of greater fibrosis AUSCULTATION Breath sounds harsh and of a bronchovesicular to bronchial character with intensification of whispered and spoken voice sounds

Remarks Cyanosis tachypnea and dyspnea may be present in advanced cases Sputum depends upon the presence of tuberculosis or bronchiectasis Clubbing of the fingers and toes is not unusual

Pneumothorax An accumulation of air in the pleural cavity either general or localized by pleural adhesions of sudden onset accompanied by pain and breathlessness and a sense of tightness (Figs 16 30)

Pathology Spontaneous pneumothorax usually resulting from a ruptured subpleural bleb or originating interstitially localized pneumothorax commonly of tuberculous origin

Physical Signs INSPECTION Negative in small amounts of air increased size of the chest with decreased movement pouting of the

interspaces of the affected side and tracheal deviation to the opposite side, in large accumulations of air PALPATION Decreased tactile fremitus in smaller quantities of air, absent fremitus in larger amounts PERCUSSION A hyperresonant to tympanitic note, varying with the degree of pneumothorax, cardiac displacement to the opposite side AUSCULTATION Breath sounds decreased to absent in proportion to the amount of air present, or distant amphoric breathing in the presence of high pressure, positive coin test succussion splash if fluid is also present

Diseases of the Mediastinum

Other than tumors of the mediastinum, pathologic processes are rare here The most common *tumors* are of lymph node origin, substernal extensions of thyroid enlargement or nodules and aneurysms of the aorta or other great arteries Therefore comments relative to physical signs will be of a general nature

Inspection Tracheal deviation has been indicated above wherever it is related to pulmonary or pleural disease, and the same is true of cardiac displacement The trachea may be displaced by mediastinal tumors also If mediastinal tumors obstruct the superior vena cava or any of its branches, dilated subcutaneous veins will appear as a collateral circulation over the upper chest neck, and shoulders bilaterally or unilaterally depending upon the site of the obstruction (Figs 1–3) Edema and cyanosis may be noted as evidence of venous stasis Pulsation in the upper chest or neck may be seen in aneurysm The eye signs of sympathetic stimulation and paralysis should be looked for as described under Abnormal Findings in the Eyes

Palpation This will probably reveal nothing unless the tumor is an aneurysm In such an event pulsation may be felt over the upper chest

Percussion As a method of examination this is often helpful in outlining by dulness a substernal extension of the thyroid Dulness to one or both sides in the second and third interspaces lateral to the sternum may accompany tumors of the hilar lymph nodes (lymphosarcoma or Hodgkin s disease) or may indicate aneurysm of the aortic arch (Fig 2)

Auscultation At times the breath sounds may be stridulous and wheezing if a tumor partially obstructs a bronchus or the trachea Aneurysmal bruits may be heard

Of the diseases of the mediastinum other than tumors *emphysema* arising from interstitial emphysema of the lungs is next most common If it is sudden and great dyspnea and tachycardia and death may occur Subcutaneous emphysema may be noted in the neck tissues, at times by extension Inspection may indicate this subcutaneous emphysema and palpation confirm it Percussion may show an absence of the usual cardiac dulness On auscultation the singular almost diagnostic *mediastinal crunch* is heard This is a loud crunching sound synchronous with the cardiac systole Furthermore, it can be brought out if the patient s arms are raised passively by an assistant while the observer auscultates over the sternal region

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12. THE HEART AND BLOOD VESSELS—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

IN THE CHAPTER on examination of the chest, it was pointed out that the roentgen ray is becoming of increasing importance in examination of the lungs Some have even questioned whether the stethoscope is losing ground in competition with the x ray in this field Such is not the case, however in the examination of the heart Though the roentgen ray may tell us much about the size of the heart of its contour and of its contractions, and though the electrocardiogram may tell us something of arrhythmias and other conduction disturbances indicative of myocardial disease it is the stethoscope only which can in trained ears make the diagnosis of valvular disease with certainty Even the heart size and types of arrhythmia can be established by routine physical examination in a high proportion of instances

In examination of the heart, the four common methods of examination—inspection, palpation, percussion and auscultation—are used to the fullest extent

Anatomic Relationships

The student will do well to visualize the anatomy of the heart and its geographic relationships to the landmarks of the chest and to other organs

The heart lies obliquely in the midchest the apex pointing down

ward forward and to the left (Figs 1–3) * The apex usually lies in the left fifth interspace about 8 to 9 cm (3⅛ to 3½ inches) from the midsternal line The base of the heart points upward and to the right lying in the second interspace The inferior border (lesser

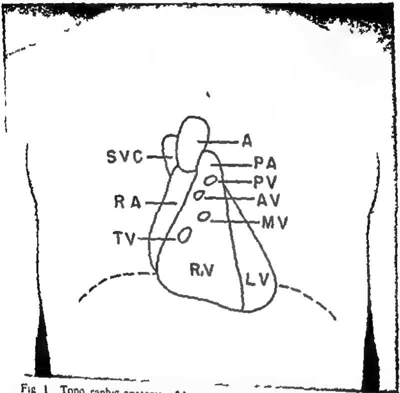


Fig 1 Topographic anatomy of heart as viewed from front *SVC* Superior vena cava *RA* Right auricle *RV* Right ventricle *LV* Left ventricle *PA* Pulmonary artery (conus) *A* Aortic arch *TV* Tricuspid valve *MV* Mitral valve *AV* Aortic valve *PV* Pulmonic valve Dome of diaphragm is indicated

curvature) of the aortic arch is usually at the level of the junction of the upper and middle portions of the sternum or at the second

* It must be emphasized that these figures are at best *schematic* True anatomic representation is impossible because of variability related to constitution as well as to the time in the respiratory or cardiac cycle in addition to even more intangible factors These figures represent an attempt to relate the position of the heart in the living rather than using the illustrations commonly used in the past based on observations in the cadaver

rib Most of the surface of the heart presenting anteriorly is made up of the right ventricle and auricle Only a strip of the left ventricle borders the right ventricle, and forms the actual apex of the heart *

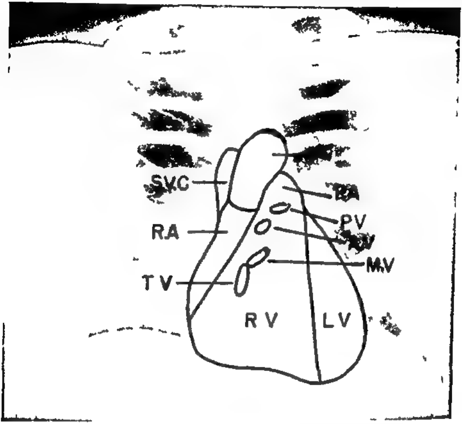


Fig 2 (Same subject as in Fig 1) Topographic anatomy of heart on x ray film as viewed from front upon inspiration

The left lung covers the heart, since it is interposed between it and the chest wall except for a small area over the right ventricle just to

* Angiocardiography a new technic for visualization of the chambers of the heart and related vessels is helpful in understanding the anatomic relationships in the living subject Immediately upon the intravenous injection of diodrast x ray exposures of the heart are made serially at intervals of one second By this means the several portions of the heart and adjacent great vessels are filled with blood containing the radiopaque material the successive filling of the cardiac structures is thereby demonstrable By this means such a controversial subject as to whether the left auricle takes part in forming the left border of the cardiac silhouette in the normal subject has been settled The left auricle may be seen to be so centrally placed that it cannot form a segment of this border Figs 4—7 show the first four exposures taken at one second intervals upon the injection of diodrast

the left of the sternum The pleural reflection lies somewhat laterally at the level of the fourth rib and interspace (Figs 5, 6 page 291 292) The area on the surface of the chest (mainly upon the left side) overlying the heart is spoken of as the *precordium*

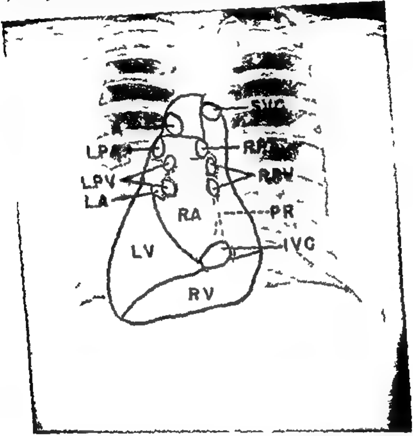
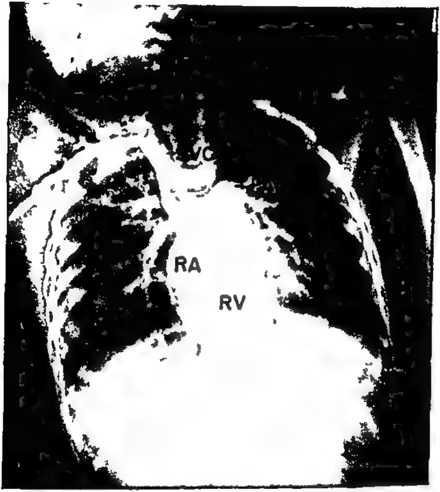


Fig 3 (Same subject as in Figs 1 2) Topographic anatomy of heart on x ray film as viewed from back. *A* Aorta *LPA RPA* Left and right pulmonary arteries *LPV RPV* Left and right pulmonary veins *SVC IVC* Superior and inferior vena cava *LA RA* Left and right auricles *LV RV* Left and right ventricles *PR* Pericardial reflection

Measurements made from the midsternal line in examination of the heart as in describing the location of the apex impulse heart borders and the like must follow certain rules The ruler is laid flat upon the anterior chest wall and the measurement taken by

the observer's line of vision being directed at right angles to the ruler In other words, no measurements are made circumferentially, that is the ruler is not bent to the curve of the chest to reach the apex impulse or outlined left border



Figs 4–7 Angiocardiograms in normal child Diodrast was injected into brachial vein X ray exposures were made at intervals of one second

Fig 4 First exposure *SVC* Superior vena cava *RA* Right auricle *RV* Right ventricle *PA* Pulmonary conus

Inspection

In careful inspection of the precordium it is best to observe this area in a good oblique light with the patient both in the recumbent and in the sitting position The latter, especially if the precordium is

inspected from several angles may reveal abnormal pulsations which may be missed in the other position

Not only must the precordium be inspected from several angles but also the region of the base of the heart Abnormal pulsations

Fig 5 (Same structures as in Fig 4) Second exposure There is greater visualization of pulmonary vascular tree

at the base are found more commonly in the parasternal areas of the first to third interspaces Therefore it is best to observe these areas not only during quiet respiration but also with the breath held in the expiratory position in order to reduce the lung volume between the chest wall and the great vessels Under such circumstances the basal

area is inspected not only from the front in the sitting position but also obliquely, the observer standing behind the patient and peering tangentially over his shoulder, the light striking the patient from the front These areas must be observed also from above the observer

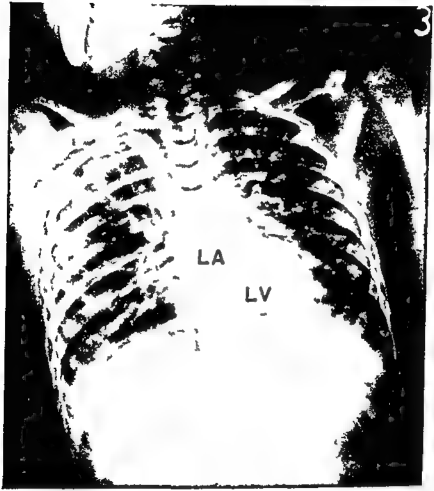


Fig 6 Third exposure *LA* Left auricle *LV* Left ventricle

standing beside the recumbent patient, and also tangentially from the side To do this the observer sits at the side of the supine patient and with his eyes at about the level of the anterior surface of the chest he carefully looks at the chest for pulsations in the area of the cardiac base (Figs 13 14 page 299 300 as applied to respiration also) As inspection is carried out the observer notes whether the pre

cordium is more prominent or bulging than the same area of the right chest

Point of Maximal Impulse Search is made for the *apex thrust* or *point of maximal impulse* (PMI) which normally is usually

Fig 7 Fourth exposure *LA* Left auricle *LV* Left ventricle *AA* Aortic arch Descending aorta can be traced into abdomen splenic and renal arteries are visible

sharply localized This impulse occurs with systole as the tip of the right ventricle (clinical apex) is pushed against the chest wall

The degree of visibility of the PMI is dependent upon several factors In the thin person with an elastic chest it may be readily seen unless it happens to lie behind a rib In the obese person the

impulse may be invisible or may be seen only as a weak thrust Women having well developed breasts often do not show a visible apical impulse In youth, the elastic chest permits a good impulse, in older age, with emphysema of the lung tissue overlying the heart a visible apical pulsation may be missing

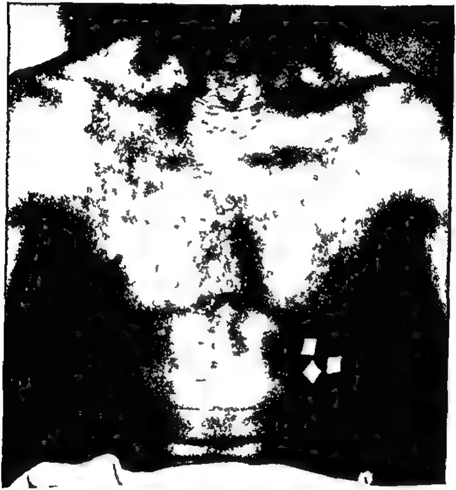


Fig 8 Mobility of point of maximum impulse Upper point its site in recumbent position lower in sitting position lateral in left lateral decubitus

The position of the PMI likewise is variable In most persons, the PMI is in the fifth interspace about 8 to 9 cm (3⅛ to 3½ inches) from the midsternal line In the asthenic person the heart hangs more centrally and therefore the PMI may be in the sixth interspace and nearer the midsternal line By contrast in the short deep chest

of the hypersthenic person with the characteristic high diaphragm the PMI may be in the fourth interspace and somewhat *laterally* (A review of Figs 3 4 6 7 10 11 pages 44 to 52 will aid in visualizing this difference) At the time of pregnancy when the gravid uterus rises to its maximum height it pushes the diaphragm upward, thereby displacing the heart somewhat *and the PMI may be displaced upward* and to the left

The position of the patient may modify the point of maximal impulse If the subject turns to his left side from the recumbent position the PMI may shift as much as 2 cm (3/4 inch) toward the axilla A lesser shift takes place to the right if the person turns to the right side In changing from the recumbent to the sitting position the impulse usually drops an interspace and may move somewhat medially The reasons for the ■ shifts should be quite obvious to the reader since the heart has a certain degree of mobility related to changes in the level of the diaphragm as well as to gravity (Fig 8)

In forced expiration and with an accompanying rise of the diaphragm *the PMI may move upward an interspace as well as to the* left because of an upward shift of the heart and its partial rotation The position of the heart in expiration is comparable to that which obtains in the hypersthenic subject By contrast deep inspiration may cause displacement of the impulse downward to the sixth interspace with some movement toward the midline This results from depression of the diaphragm and elongation of the thoracic cavity Such a displacement causes a condition comparable to the cardiac position in the hyposthenic subject (The effects of the respiratory cycle upon the position of the heart may be noted in Figs 3 4 6 7, 10 11 pages 44 to 52)

In addition to the position of the apex impulse note should also be made of the size of the area over which the *movement is seen* Normal individuals usually show an area of pulsation about 2 cm in diameter The character of the normal impulse may vary within certain limits A sharply localized prominent or *quick active impulse* is seen in the young spare person because of the elastic chest wall This may be *accentuated* by an increased heart rate irrespective of age if the subject is excited as by the examination for example Similarly this is also true as the student well knows after exercise

In the normal old person, the apex impulse may be less prominent and apparently less quick because of lessened elasticity of the chest wall

Careful observation of the PMI may demonstrate arrhythmia of the heart cycle by the irregularity in time intervals at which the thrust appears, as well as differences in the force of the beat This point will be considered more fully in the following chapter, since most arrhythmias represent an abnormality or disease (Sinus arrhythmia, however, occurring in normal persons and dependent upon the respiratory cycle will be described under the heading of Auscultation since it can be more accurately evaluated by such examination than upon inspection of the apex beat)

In some normal persons especially in those having an elastic chest wall—that is in young persons—a systolic retraction of the lower sternal area and of the lower precordium just to the left of the sternum may be observed This occurs because at systole the wall of the right ventricle moves toward the interventricular septum away from the chest wall

It should not be forgotten that inspection of the neck veins and arteries as described in Chapter 7, constitutes part of the cardiovascular examination

Epigastric pulsation as will be noted in the chapter on the abdominal examination is usually due to the abdominal aorta and is found at its best in lean persons The third portion of the sternum may exhibit pulsation when the heart is overactive as after exercise or during excitement This actually represents a systolic retraction as noted above

Palpation

Palpation of the chest over the precordial area as well as of the base of the heart should be the next step in the examination of the heart Though the finger tips may be used to localize the apex impulse or abnormal pulsations it is my feeling that the application of the palmar aspect of the distal two phalanges and even the whole palm of the hand is more effective (The palmar region of the metacarpophalangeal joints may be used with especial ease) The hand should be shifted from place to place over the cardiac area Palpation

may be used both in the recumbent and in the sitting position The examiner should not forget that upon forced expiration the lungs are retracted somewhat from over the heart, uncovering it, as it were and permitting its closer apposition to the chest wall Thus normal and abnormal palpatory findings may be demonstrated at times only upon asking the subject to exhale and to hold his breath Such a maneuver

Fig 9 Palpation in left lateral decubitus Helpful in demonstration of thrill of mitral stenosis

may be aided by the patient s position Palpation of the apical region may be done best in the left lateral decubitus (Fig 9) In palpation of the base of the heart the patient is asked to assume the sitting position and to lean forward (Fig 10) In general palpation provides more information than does inspection

Palpation is used to confirm inspection with relation to any bulging which may be present over the precordium More especially it not only will permit the confirmation of the site of the apex impulse but

may localize it even in the absence of a visible impulse This technic provides a means of localizing the apical impulse in the obese subject over a large breast and even at times in the presence of emphysema (The large female breast may be displaced upward by the palpating hand or be held up by the other hand so that more adequate palpation may be carried out) Not only does palpation localize the beat

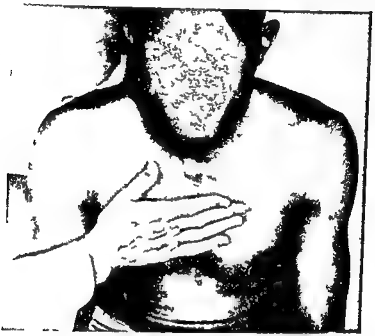


Fig 10 Palpation for shocks thrills and pulsations at base of heart

but it should be used also to establish whether it is sharply localized or diffuse whether it is quick or of a more slowly heaving character Furthermore irregularity of the cardiac rhythm can be more accurately noted by palpation

In the normal person the PMI is usually rather sharply localized and is quick that is it strikes the hand sharply and recedes (This feature may be accentuated in the overactive heart of excitement because of the examination) The PMI normally can be demonstrated to shift with changes in position

Palpation for abnormal pulsations is carried out especially at the base of the heart—from the first to third interspaces bilaterally and over the upper half of the sternum These are often best (or only) demonstrated during expiration

(A palpatory finding usually found only in disease is the *shock* to be considered in the next chapter Rarely it is felt in an overactive apparently normal heart Two types of vibration which are abnormal and of great diagnostic significance may arise from the cardiovascular structures The first is the *thrill* and the second the *friction rub* The presence of abnormal palpatory findings in disease will be noted in the next chapter)

Palpatory examination as applied to the heart should also include palpation by one or two fingers placed in the suprasternal notch Normally no pulsation is felt here as a usual thing Occasionally in thin persons and at times in excitement or after exertion pulsation may be demonstrated in the absence of disease As will appear later pulsation at this site may be significant

Percussion

In the past much has been made of percussion of the heart It is the author's opinion that of the four routine methods of physical examination of the heart percussion contributes in general the least It may confirm the impression of cardiac enlargement already gained by inspection and palpation By percussion the left border can be outlined with reasonable accuracy even by the beginner * At times it will be helpful in demonstrating disease of supracardiac structures Accuracy in outlining the cardiac shape is definitely poor In this day of the teleoroentgenogram an attempt to draw conclusions concerning the shape of the heart by percussion is almost useless Though I have repeatedly indicated that my objective in this book is to approach physical diagnosis as one should use it in practice I reiterate that percussion adds little to the wealth of information gained by inspection palpation and auscultation of the heart †

* For years I had my students percuss the left border and apply short sections of wire to the chest with adhesive tape along the outlined border Then with the fluoroscope the students have had an opportunity to see the results of their percussion In general they have been accurate within about 1 to 1 5 cm ($^2/_8$ to $^9/_{16}$ inch) in the fifth and fourth interspaces the greatest error appearing in the third interspace

† Further proof of this statement is the fact that the examiner will find himself being unconsciously influenced in his percussion of the left cardiac border by the visible or palpable PMI

Technic The surest technic is probably that of mediate percussion, as described in the chapter on examination of the chest With the patient recumbent on a table or bed, the observer stands at the patient's right side, he places his pleximeter finger well toward the left anterior axillary line in an interspace and moves it slowly toward the midline as blows are struck by the plexor finger (The heart is

Fig 11 Percussion technic for outlining left cardiac border pleximeter parallel to ribs

a solid organ containing no air covered by air containing lung tissue on the right side Lung covers it in its upper portion and to a lesser extent over the lower portion on the left side) Thus as the pleximeter finger moves medially over the region of underlying lung tissue it will finally reach a point where the underlying solid heart gives a dull note This will represent the *left border of cardiac dulness* (Actually this is somewhat inaccurate even with careful percussion as checked by the x ray The anatomic border is slightly lateral to the percussed border since the overlying pulmonary resonance prevents accurate delineation of dulness)

Since the percussion is of a convex surface, care should be taken that the pleximeter finger is firmly applied at each position and that the plexor strikes the pleximeter at an angle vertical to the lateral plane of the body (Fig 11) Thus percussion is carried out as

described the pleximeter finger moving medially from the left axillary region in the sixth fifth fourth third and second interspaces in this order By marking the site of the first dull note in each interspace with a skin pencil the left border of cardiac dulness may be outlined (The inferior border of the heart cannot be determined because the cardiac dulness blends with liver dulness)

Some clinicians point out that the use of the pleximeter finger applied in its long axis in the interspace leads to inaccuracy They insist that by placing the pleximeter finger parallel to the cardiac border the inaccuracy due to too wide a pleximeter is eliminated Therefore they recommend that the pleximeter finger should be held at right angles to the ribs and interspaces Such a position is awkward when used on the recumbent patient from either side (Awkwardness makes for inaccuracy) Nevertheless I grant that this technic can be applied in the examination of the patient examined in the upright sitting or standing position Such a technic may be used more readily in percussion for the right cardiac border in the recumbent person* (Fig 12)

In the percussion of the right border I believe it is well to outline first the level of hepatic dulness in the right parasternal region Then an attempt is made to demonstrate dulness to the right of the sternum in the fourth third and second interspaces approaching the right sternal border from a distance of several centimeters to its right Dulness encountered in such interspaces is marked with a skin pencil to visualize the right border of the heart (Fig 30 page 327)

In selected instances one may shift the person from the recumbent position to the left or right side to demonstrate cardiac mobility as shown by the changing border of the cardiac dulness Absence of such a shift may indicate disease

After the left and right borders are outlined by percussion it

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In the past some authors have considered *orthopercussion* mentioned in Chapter 10 to be theoretically finer and therefore more accurate Few students become such masters of this technic as to urge its use Again if knowledge of the cardiac contour is so important in diagnosis today the cardiac silhouette as obtained by x ray should be used Certain clinicians adept at *immediate* percussion feel they can more accurately outline the cardiac border by this method I agree that one can do very well with such technic However for the student reader of this book who will do well to master the usual mediate percussion I do not recommend immediate percussion (Fig 13) (For a description of these methods see Chapter 10)

is well to percuss carefully the supracardiac region This includes the first and second interspaces in the left and right parasternal areas as well as the manubrium and upper portion of the second part of the sternum

Percussion Findings in the Normal In the normal subject, the left border can usually be outlined only in the fifth, fourth, and third interspaces, 7 to 10 cm (2¾ to 4 inches), 5 to 7 cm (2 to 2¾

Fig 12 Pleximeter finger at right angle to ribs in mapping left cardiac border

inches) and 2 to 4 cm (¾ to 1½ inches) from the midsternal line respectively In the absence of disease, dulness is practically never demonstrated to the right of the sternum, that is the right cardiac border normally is not demonstrable by percussion, except as may appear below

The left border of dulness is *relative* since it is a product of the percussion note produced in a solid organ modified by overlying aerated lung tissue If the pleximeter finger is moved medially a flat note may be demonstrated in both the fourth and fifth interspaces from a distance of about 3 cm (1¼ inches) to the left of the sternum to the midsternal line This flatness represents the area of the heart not covered by lung and is described as the area of *absolute* cardiac dulness (Fig 30 page 327) Mapping out absolute dulness is of no clinical importance but is mentioned merely because the novice often

does not readily recognize any cardiac dulness until he reaches the area of absolute dulness

In the normal subject usually no dulness is demonstrable in the supracardiac region Occasionally thin flat chested persons may be shown by careful percussion to have an area of impaired resonance about 5 cm (2 inches) wide in the second interspace in the sternal area owing to the underlying great vessels

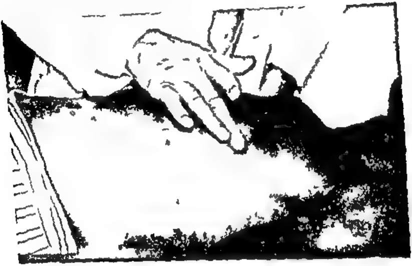

Fig 13 Outlining left cardiac border by immediate percussion

Mapping the cardiac border in the normal subject may be associated with inaccuracies or at least be modified by certain variations within normal limits *The most frequent* circumstance interfering with accurate percussion of the left border is gastric tympany The air bubble in the fundus of the stomach lies immediately beneath the dome of the diaphragm Thus as the examiner attempts to demonstrate the relative dull note of the left border of the heart he encounters the tympanitic note produced in the stomach This is especially likely to interfere in the fifth and often also in the fourth interspace By now it also will be obvious to the reader that a thick chest wall or a large breast in the *female will* prevent accurate determination of the cardiac border by percussion though the breast may be displaced upward for greater accuracy

As has been pointed out repeatedly, body habitus influences greatly the findings relative to the viscera The short, broad chested hypersthenic person will have the left border of heart dulness well to the left in the absence of disease At the other extreme, the long thin chested asthenic person will have a heart hanging almost in the mid line, with a left border only several centimeters to the left of the mid sternal line and even as low as the sixth interspace It is in such a person that a right cardiac border may be percussible under normal circumstances, because of the centrally placed heart (Fig 11, page 52)

Just as the phases of respiration may cause changes in the position of the PMI, so too the border of cardiac dulness may be modified In full expiration, the diaphragm having risen, there is shortening of the chest, and the left border of the heart is displaced laterally, in creasing the area of dulness, quite comparable to the position of the heart in the hypersthenic chest During full inspiration, the heart moves medially with descent of the diaphragm the left border moving toward the sternum and thereby decreasing the area of dulness (Figs 3, 4, 6, 7, 10 11, pages 44 to 52)

The uterine enlargement of pregnancy, in the latter months, causes a rise of the diapraghm with at times, an upward and lateral displace ment of the cardiac dulness

The greater resilience of the chest wall in youth with a less com plete covering of the heart by the lung, accounts for a comparatively greater area of dulness in the younger years of life than in older age

AUSCULTATION

Though it has been implied in the foregoing portion of this chapter, and will be shown in the following chapter, that much can be learned about the heart by inspection, palpation, percussion and by the use of the electrocardiogram and the roentgenogram auscultation is the most important method of examination of the heart The stethoscope offers the only means by which the diagnosis of valvular disease can be established with certainty

Auscultation may be carried out in the *immediate* fashion by plac ing the ear directly against the bared chest of the subject Actually,

there is no need for this except in emergencies when the physician does not have his stethoscope with him An instrument is preferable not only for esthetic reasons but also because of the better localization of sounds The bell type of stethoscope in my opinion is the better for general use though under certain circumstances as will be brought out in the following chapter the Bowles instrument has an advantage With the stethoscope one may evaluate (1) the first and second heart sounds (occasionally a third sound), (2) the rhythm of the heart cycle and (3) abnormal sounds such as murmurs friction rubs and cardiopulmonary murmurs *

Several fundamentals may well be emphasized for the beginner

Apex Beat and Auscultation Until the student recognizes the two heart sounds he can best *time* the sounds by watching or by palpating the apex beat which represents cardiac systole Even when he recognizes the cardiac sounds by their auscultatory characteristics the beginner will find that he can best time murmurs by correlating them with the apex beat Though the experienced physician quickly recognizes the heart sounds and the usual murmurs even he may need to resort to the use of the apex beat in timing unusual murmurs or sounds especially in the presence of a rapid heart rate or when the quality of the sounds is abnormal If the apex beat is neither visible nor palpable the examiner should use the pulsation of the common carotid artery as an aid in orientation in the cardiac cycle The index finger of the left hand placed between the sternocleidomastoid muscle and the trachea will give this information (The use of the radial artery pulse for this purpose is not satisfactory especially in the presence of tachycardia because the time lag is great enough to be confusing)

Position A complete cardiac examination requires auscultation in both the supine and the upright position and at times with the patient lying upon the left side These positions may be essential in the evaluation of murmurs Some are heard only or at least certainly in one position being absent or faint *in other* positions Preliminary auscultation should be carried out in the same *position* as that in

* No consideration will be given to conduction of the impulse through the heart and the production of the cardiac cycle This was le rned presumably in the course on physiology and if the student is not certain of his knowledge in this respect he must review it

which inspection, palpation and percussion were applied Postural changes may be introduced later Just as palpation of the base of the heart in the sitting position and leaning forward (Fig 10) may be more rewarding in certain forms of heart disease the same is true of auscultation in the same position This is true also of the left lateral decubitus (Fig 9)

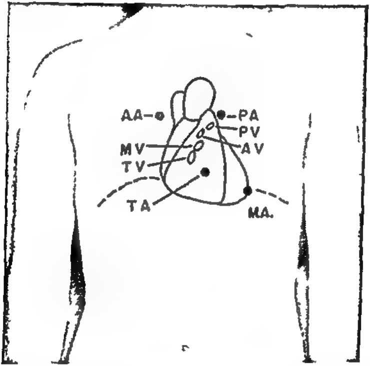

Fig 14 Topographic anatomy of heart valves and valve areas as viewed from front *MV* Mitral valve *MA* Mitral area *TV* Tricuspid valve *TA* Triscupid area *AV* Aortic valve *AA* Aortic area *PV* Pulmonic valve *PA* Pulmonic area

Respiration This is important as related to cardiac auscultation For the novice, the breath sounds are disturbing while he is listening to the heart He must learn to disregard them and train his ear to listen only to cardiac or respiratory sounds as may be necessary However at first he may ask his subject to hold his breath as he analyzes the normal heart sounds or abnormal sounds Later even though experienced in auscultation he may wish to intensify distant or weak heart sounds by listening in the expiratory phase Then the

heart is bared to the maximum by retraction of the overlying lung He may wish to note the relationship of an extraneous sound to the respiratory cycle So too he may wish to correlate cardiac rhythm with respiration

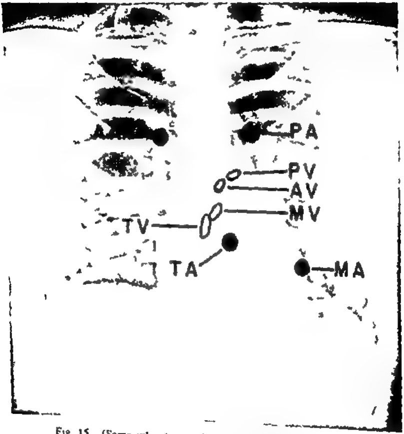

Fig 15 (Same subject as in Fig 14) Topographic anatomy of heart valves and "valve areas" on x ray film

Exercise This may be mild of one type or another Having the patient walk across the room hop up and down or lie down and sit up a number of times will increase cardiac activity thereby affecting the quality of the heart sounds modifying the rhythm and bringing out or causing the disappearance of murmurs

Valve Areas Though auscultation should be carried out over the whole precordium and supracardiac area, several areas have been shown to be of especial significance Routine examination by the experienced clinician is often limited to these areas, more extended investigation being carried out if abnormalities are encountered

Anatomically, the four valves—aortic, pulmonic, tricuspid, and mitral— are clustered beneath an area of the chest wall several centimeters in diameter under the third interspace just to the left of the sternum and under the sternum adjacent to this Experience has shown that murmurs produced at the respective valves are heard best not at their anatomical site but at a point somewhat distant usually determined by the direction of blood flow These areas, for auscultatory purposes, have become known therefore as 'valve areas (Figs 14 15), and are designated and localized as follows

Mitral Area This is in the fifth interspace near the nipple or midclavicular line

Tricuspid Area This area is localized to the junction of the second portion of the sternum with the ensiform cartilage

Pulmonic Area Sounds produced at the pulmonic valve are heard best in the second interspace at the left of the sternum

Aortic Area Like the pulmonic area, this is in the second interspace but to the right of the sternum

Customarily, routine auscultation is begun at the mitral area with analysis of the heart sounds here Then the bell of the stethoscope is moved with one or two stops for listening to the tricuspid area Next the examiner should listen at several points at the left border of the sternum as he approaches the pulmonic area Finally, he ends auscultation with examination of the pulmonic and aortic areas

If an abnormal sound is heard at any one of these areas the stethoscope chestpiece must follow this sound in several directions away from the area to note the direction of transmission if any, of the abnormal sound This will be discussed in detail in the next chapter

HEART SOUNDS

As the student knows from his physiology the heart sounds have a definite sequence related to conduction of the impulse through the heart and thus to the contraction of the heart chambers

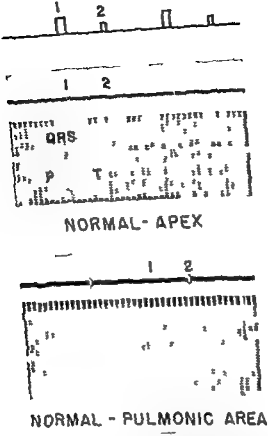

Fig. 16 Graphic representation of heart sounds QRS complex *represents* ventricular contraction Simultaneous stethogram indicates vibrations due to first sound at *1* block *in schematic diagram* at top represents first sound at *1* smaller vibration at 2 represents second sound block at II indicates sound shorter and less loud than first sound Upper record was taken with chestpiece over apex and lower one was recorded over pulmonic area thereby explaining differences in vibration intensities

Usually there are heard two heart sounds the first marking systole and the second the beginning of ventricular diastole As in the case of sounds produced in the lungs we are interested in (1) the quality (2) the pitch (3) the intensity and (4) the duration of both normal and abnormal sounds originating in the heart

First Sound This occurs simultaneously with ventricular systole and the apex beat and is due to the sudden closure of the mitral and tri

cuspid valves * It has been described classically in all textbooks as the syllable *lubb* It thus has the characteristics of a dull quality, of a low pitch, of fairly loud intensity at the apex, and of long duration (Fig 16) It is less intense as heard at the pulmonic or aortic area, being very faint at times in hypersthenic persons

Second Sound The pulmonic and aortic semilunar valves snap shut at the end of systole to produce the second sound It is described by the syllable dup The second sound is of a snapping quality, of high pitch of moderately loud intensity at the cardiac base and of short duration It is less intense at the mitral or tricuspid area The intensity of the two second sounds as heard at the pulmonic and aortic areas may vary, depending upon circumstances to be noted below and in the next chapter

The first sound is followed after a short pause by the second one A longer pause (two or three times longer) falls between the second sound and the beginning of the next cycle The difference in these intervals is more noticeable to the beginner in slow heart rates, of 72 per minute let us say than in rapid ones of 120 per minute for example Above this rate the pause between the heart sounds is about equal If the student will repeat out loud lubb dup lubb dup, he will have some idea of what he is to hear as he first places his stethoscope over the heart

Third Sound In children or young adults a third sound heard early in diastole (immediately after the second sound), is encountered not infrequently especially in the recumbent position or when the subject is lying on his left side The pitch of this sound is low it is of faint intensity and is heard at the apex or in the third or fourth interspace The third heart sound is thought to be due to the sudden opening of the auriculoventricular valves in diastole though some authors believe the rush of blood into the ventricle is an additional factor If the third sound is quite prominent it may produce a rhythm suggestive of a gallop This may simulate the protodiastolic—early diastolic—gallop rhythm of disease

Normal Variations of the Heart Sounds *First Sound* In children, the heart sounds are commonly of greater intensity and

* There are some who believe that the ventricular contraction contributes a muscular component to the first sound

of shorter duration than in adults (Infants usually having a rapid rate and a shortening of the first sound present heart sounds similar to the ticking of a watch *embryocardia*) With exercise or excitement the increased heart rate is accompanied by an accentuation of the intensity of the sounds

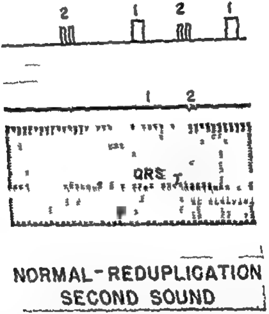

Fig 17 Reduplication of second sound in healthy young man Double series of vibration is shown at 2 in stethogram (chestpiece applied in pulmonic area) Two blocks in diagram indicate the two sounds heard with stethoscope

The first sound is diminished in intensity normally in the resting person and in one with a thick chest wall or in a woman with large breasts Obviously the greater the amount of tissue between the heart and the stethoscope bell the poorer will be the transmission of the heart sounds

The first sound may be *reduplicated* even in the absence of disease Since both the first and second sounds consist of two components or sounds one from the left the other from the right side of the heart there may be asynchronous cardiac activity thereby producing

prolongation or actual reduplication of either sound More often than not, however, this means disease, especially in the case of such a change in the first sound

Second Sound The intensity of the second sounds at the base varies a great deal with age in normal persons In the first two or three decades of life, the second sound at the pulmonic area is louder than at the aortic area because of pulmonary elasticity and greater intrapulmonary pressure In the next two decades the intensities of the pulmonic and aortic sounds are more likely to be equal From middle age on the aortic second sound tends to become more intense than the pulmonic one because of increasing pressure in the greater circulation uncoiling of the aortic and thickening of aortic valve cusps

Reduplication or asynchronicity of the second sound at the pulmonic area in young persons is not uncommon, and is related to the respiratory cycle (Fig 17) Asynchronous valvular closure with reduplication of the pulmonary second sound may be produced in the recumbent person during deep expiration

Murmurs The subject of heart murmurs is a most important one since a murmur may be indicative of valvular, myocardial or vascular disease It may also be due to an alteration in hemodynamics The detailed discussion of these features will be reserved for the next chapter in order to forestall confusion

At this point we must concern ourselves with some general principles of murmurs their description and discussion of those which occur in the absence of disease

Murmurs are vibrations set up in the cardiovascular structures to be heard as sounds in addition to the usual first and second heart sounds Therefore certain features or characteristics must be noted in their evaluation

Relationship to the Cardiac Cycle The observer must time the murmur as to whether it is present in systole or in diastole and where it appears in the respective portion of the cycle

Duration Murmurs may be spoken of as short or prolonged as related to a portion of a cardiac cycle

Site Radiation or Distribution Though a murmur is usually related to one of the valve areas it commonly radiates to some distance

from the area Therefore note must be made of the extent and direction of radiation

Pitch Murmurs may be of low pitch or high pitch

Quality Descriptive terms characterizing the quality of murmurs are commonly applied such as short or long blowing whistling soft rough rumbling machinery like etc

Intensity Murmurs may be faint distant or loud They may be of crescendo decrescendo type the intensity varying in certain phases of the murmur

Relationship to Position of the Patient Exercise and the Respiratory Cycle Certain murmurs commonly appear or disappear with change of position that is the recumbent or upright position Exercise may cause murmurs to appear or disappear Furthermore, murmurs may appear or disappear in relation to inspiration or expiration

The classification of murmurs as being either *pathologic* or *physiologic* has been commonly accepted The former are clearly related to disease The latter are not The causation and characteristics of pathologic murmurs will be considered in detail in the next chapter

Physiologic murmurs of intracardiac or intravascular origin occur in the absence of disease The great majority of them occur in young persons A history of no previous cardiac disease nor of decreased myocardial efficiency is important in the evaluation of murmurs in young people The cause of physiologic murmurs is unknown in many instances It seems likely that in youth and therefore in elastic chests intrathoracic and intrapulmonary pressure changes may well explain some of the physiologic murmurs of intracardiac or intravascular origin The following may be accepted as common characteristics of physiologic murmurs

1 Practically all of these murmurs are systolic in time

2 The majority are heard at the pulmonic area without radiation The other frequent site is at the cardiac apex such a murmur also being heard upward along the sternum and at times at the pulmonic area as well

3 They are usually high pitched

4 The murmurs are characteristically *short and blowing*

5 Though these murmurs are usually soft occasionally loud ones may be heard

6 Commonly such murmurs are heard only in the recumbent position and will be found to disappear at some angle in the assumption of the upright *position*

They may disappear upon inspiration and become louder upon expiration They may be brought out by exercise or be made to disappear with exercise

7 Lastly such murmurs may be present or absent under apparently the same conditions at several different examinations

The most frequent of the physiologic murmurs are those systolic in time and heard at the mitral and/or pulmonic areas

The *mitral murmur* is heard at the apex, and may radiate little or widely toward the base of the heart and axilla It may appear only in midsystole or extend only through early systole It is usually of high pitch, usually has a blowing character, though at times is somewhat harsh Its intensity may vary from a soft to a very loud degree Such a murmur may disappear on deep inspiration and upon exercise as well as upon sitting up

The *pulmonic murmur* is a blowing early systolic murmur, heard at the pulmonary area with no radiation or with slight radiation downward along the left sternal border It varies in intensity The effects of respiration and change of position are marked If present in the recumbent position it may disappear in the sitting position It may appear in the upright position if the subject leans far forward

Extracardiac or cardiopulmonary murmurs are probably due to air being squeezed out of the lappet of lung overlying the heart by systolic contraction Usually they are heard at their best in a state of partial inflation of the lung Certainly they vary in intensity with some phase of inspiration The disappearance of the murmur with the breath held in expiration differentiates the cardiorespiratory murmur from the intracardiac murmur

The *xiphosternal crunch* is heard not uncommonly over the lower sternum and ensiform cartilage especially during systole, and may be mistaken for a murmur or friction rub It is a grating or rubbing sound of unknown cause and of no pathologic significance

CARDIAC RHYTHM AND RATE

Though inspection or palpation of the apex impulse and palpation of the arterial pulse may demonstrate arrhythmias of the cardiac cycle, auscultation is the best means of evaluating disturbances of rhythm exclusive of the electrocardiogram (An understanding of the arrhythmias necessitates a review of the physiology of cardiac

activity) The abnormal arrhythmias and rates will be considered in the next chapter

Normal Sinus Rhythm This is usual in the well person characterized by a rate of 60 to 90 beats per minute The cardiac cycles at a given time are of equal lengths, or in other words the beat is regular (Fig 18)

Sinus Tachycardia Under such circumstances the heart beats rhythmically but rapidly at a rate of over 100 beats per minute The

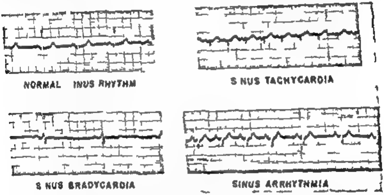

Fig 18 Electrocardiograms to illustrate normal sinus rhythm at rate of 75 per minute sinus tachycardia rate of 150 per minute sinus bradycardia rate of 43 per minute sinus arrhythmia varying from rate of 100 in left half of tracing to 60 per minute in right portion

sino auricular node is stimulated to set the pace at an increased rate This occurs in the absence of disease with exercise and with emotional disturbance the latter often shown upon the first visit to the physician s office (Fig 18)

Sinus Bradycardia If the sino auricular node sets a pace at less than 60 beats per minute the condition is known as sinus bradycardia It is a normal finding in some persons (Fig 18)

Sinus Arrhythmia It is surprising that a phenomenon encountered in everyday practice is described with no uniformity in text books of medicine physical diagnosis or cardiology Though all seem to agree that an increase of vagal tone occurs with expansion of the lungs to be reflected in slowing of the heart rate an effect which may be abolished by atropine the definition of sinus arrhythmia

varies greatly Most authors loosely describe this arrhythmia as a quickening of the rate with inspiration and a slowing upon expiration Some are more specific saying that it quickens at the beginning of inspiration and others on the other hand, decribe the increased rate as occurring late in inspiration These definitions have implications which are contrary to physiologic facts and thus confusing to the student If slowing is due to increased vagal tone, and if full respiration (shown at its best by holding a deep breath) stimulates the vagus the implication that the cardiac rate is quickened by inspiration is incorrect

Actually, what seems to happen is that slowing occurs as the height of inspiration is approached being carried over into expiration, and that the apparent quickening at the onset of inspiration is in fact the effect of the release of increased vagal tone

Sinus arrhythmia is a common finding in normal children and in youth into the twenties (Fig 18) It becomes less frequent with increasing age However even in later years deep inspiration may cause a variation in rate

The Pulse

Much can be learned from palpation of the larger peripheral arteries of which the major item is the pulse In the days before modern medicine, much attention was given to the pulse As will appear below and especially in the following chapter cardiac disease can often be diagnosed quite well by the pulse Nevertheless, I have placed its discussion after the section on cardiac examination since so far as heart disease is concerned, most of what the pulse shows and more can be learned with the stethoscope

The pulse may be felt adequately in a number of the peripheral arteries The temporal, carotid brachial radial femoral popliteal posterior tibial and dorsalis pedis arteries are commonly palpated for one reason or another in cardiovascular disease These arteries may on occasion be seen to pulsate Actually the movement of the artery is not the pulse wave but represents a displacement of the vessel The pulse wave does not represent the movement of blood along the artery but indicates an impulse transmitted to a column of blood by the ejection of blood into the aorta at ventricular systole

The artery usually used in examination is the radial artery. In carrying out palpation for the pulse several fingers should be laid on the radial artery just proximal to the wrist joint (Fig 20). Several fingers are preferable to one finger for the several finger tips offer a larger sensitive palpatory surface with which to note the pulse wave and any alterations in it. At times it may be worth while to encircle the wrist lightly. Then the examiner's hand is so placed that the palmar surface of metacarpal phalangeal joints overlies the radial artery. In each instance the pulse of the two radial arteries should be examined simultaneously for comparison of the strength and type of pulse wave as well as for synchronicity.

The palpating fingers having found the radial artery they will note *its position* whether it is at the usual site or not. Congenital anomalies of position and depth or superficiality are not unusual in the vascular system. Having located the artery the fingers first should be used to determine whether the course of the artery is *straight* or *tortuous*. Tortuosity is indicative of arteriosclerosis since the sclerotic vessel in losing elasticity lengthens and takes a more serpentine course. The thickness of the vessel wall may be easily evaluated by compressing a portion of the artery proximally with the left hand and then rolling the empty distal segment under several fingers of the right hand. Normally in the absence of arteriosclerosis the empty vessel should be impalpable. However with advancing age from middle life onward palpable arterial walls are so common that the thickening must be considered to be physiologic.

Having obtained this information concerning the artery itself the observer will note the *fulness* or *volume* of the pulse. The examiner estimates the systolic filling and diastolic collapse. Usually the more rapid the rate the smaller the pulse volume. *Tension* of the pulse wave and its *compressibility* are also gauged. Compressibility is defined as the pressure needed by the palpating fingers to obliterate the pulse wave.

Next attention will be given to the *rate* of the pulse. The comments made relative to normal sinus rate, sinus tachycardia and sinus bradycardia above under the subject of rhythm will apply here.

Likewise the observer will note the *rhythm* whether it is a normal sinus rhythm as described under auscultation or whether any abnor

mality of rhythm exists In normal persons, especially in young subjects, one should expect to find only sinus arrhythmia This can be recognized as readily by *palpation of the pulse as upon auscultation* of the heart

The *wave* of the pulse was considered to be of great importance in former days, and was extensively studied by the sphygmograph However,

Fig 19 Technic for demonstration of capillary pulse Pressure on nail blanches distal portion of nail bed

ever, auscultation of the heart in conjunction with electrocardiographic studies has outmoded the use of this instrument, and little attention is given nowadays to the details of the pulse wave Normally the pulse wave strikes the palpating fingers rather quickly, but not suddenly, so that one gains the impression of a momentarily increasing gradient, this is sustained at a level briefly and then *falls*

off With sinus tachycardia from excitement or emotion, the wave rises more quickly is sustained for a briefer interval and then drops more rapidly The student will need to feel the pulse in many persons to become familiar with the normal

Capillary Pulse This is not searched for in the routine examination of normal persons In fact it is extremely difficult to see the capillary pulse in normal persons It may be of interest in the presence of certain types of cardiac disease

A capillary pulse may be demonstrated by the following maneuvers The tip of one of the subject s fingernails may be pressed upon to produce a blanched area in the nail bed or a glass slide may be pressed against the skin over the forehead with just sufficient pressure to produce blanching If the pulsation is demonstrable the line demarcating the pink from the blanched area in the nail bed will move distally at systole decreasing the blanching (Fig 19) With the glass slide test the color will return to the skin with systole A capillary pulse may be demonstrated at times by transillumination of a finger tip with a small flashlight a darkening and lightening occurring with systole and diastole respectively

Auscultation of Arteries Normally auscultation over an artery reveals no sound unless the stethoscope bell partially compresses it Such an obstruction will produce a systolic murmur

Blood Pressure

The determination of the pressure in the systemic circulation with a sphygmomanometer is a routine procedure in every complete physical examination and in life insurance examinations It gives most important information regarding the cardiovascular renal systems from both diagnostic and prognostic angles

Though it was noted above that the tension of the pulse as determined by palpation is an expression of the blood pressure it is at best a crude method for obtaining this information even in the hands of the most experienced clinicians In 1896 Riva Rocci introduced the present method of obstructing an artery by an inflated cuff the systolic pressure being determined by noting the return of the pulse

as the pressure is decreased About a decade later, the auscultatory method, now used universally was introduced, permitting the determination of both the systolic and diastolic levels

Method Blood pressure determination is carried out by wrapping snugly about the *bare* upper arm, a rubber bag encased in a cloth

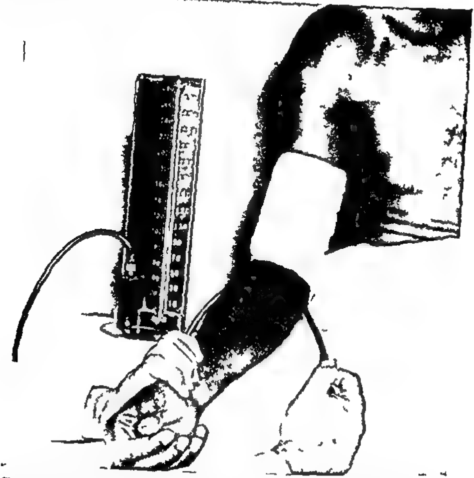

Fig 20 Determination of systolic blood pressure by applying several fingers to radial artery before using stethoscope as in Fig 21 (note even application of cuff)

cover to permit an even distribution of pressure This rubber bag is inflated by a bulb By placing the fingers of one hand on the radial pulse and noting its disappearance the observer finds the level of pressure above which the radial pulse is obliterated The stethoscope bell is then placed in the antecubital fossa toward the medial side The

pressure in the bag is slowly released by an air valve at the bulb Certain sounds are then listened for to be interpreted as indicated below The pressure is read in terms of millimeters of mercury in a sphygmomanometer either having a column of mercury from which readings are taken directly or from an instrument constructed on the aneroid principle calibrated in terms of millimeters of mercury

Several points must be made regarding this apparently simple procedure The pressure applied to the upper arm obstructs the brachial artery through a constricting pressure in the soft tissues of the extremity (Fig 20)

The pressure of the bag must be applied uniformly therefore, there must be no wrinkles in the cloth cover of the bag The bag *must not be permitted to bulge* beyond the cloth cuff If it does the constricting mechanism is applied more like a tourniquet over an area of 2 5 cm (1 inch) or so in width instead of the wide uniform pressure of 10 to 12 5 cm (4 to 5 inches) of the properly applied cuff This point must be watched especially carefully in obese persons Ragan and Bordley have shown that if auscultatory and intra arterial systolic measurements are compared the size of the subject s arm is a factor to be considered Auscultatory measurements were usually too low in persons with small arms and too high in those with large arms The use of a 20 cm wide cuff in obese subjects instead of the standard 13 cm width cuff gave more accurate measurements in both systolic and diastolic pressure readings In other subjects however the readings were too low The authors point out that blood pressure determinations are not really accurate and that the error in either large arms or small arms may be as great as 30 mm of mercury

As was noted above it is well to palpate the radial artery while inflating the cuff until the pulse disappears and then to apply the stethoscope The purpose of this is to avoid error through the occasional phenomenon of the *auscultatory gap* A reading should be made by permitting the pressure to drop slowly (2 to 3 mm per second) so that an accurate level may be noted (If the pressure is permitted to drop too rapidly it may drop 10 mm between beats and thus be inaccurate A slow drop might have permitted the reading at a level 10 mm higher) After the readings of the systolic and diastolic levels are made the pressure should be released completely to relieve

venous stasis for the patient's comfort, and then the procedure should be repeated to check the first reading

Auscultatory Method The pressure having been raised above the level at which the palpable pulse disappears, auscultation is carried out

The *first sounds* heard represent the *systolic pressure* being due to the returning beats in the artery, and sound much like the apical heart beat Next, the sounds change slightly and briefly and then become louder to remain at this intensity for some 20 to 30 mm below the systolic level in normal persons At this point, the sounds become feeble, this change represents the *diastolic pressure* the level of pressure in the vessels in diastole Feeble sounds continue to be heard for another 10 mm or so as the pressure drops and then disappear completely

In both the healthy subject and in the presence of disease, the student may encounter the condition in which beats come through down to the zero level This does not represent a zero diastolic pressure, but means that the change representing the diastolic pressure level was not recognized The continuing beats to the zero level occur in vasodilatation and under other circumstances to be noted in the next chapter

Palpatory Technic This permits the recognition of variations of the normal and abnormal in the auscultatory technic At times, apparently, if the artery is relaxed it may transmit sounds of the blood beating against the constriction These may be heard by the auscultatory method at 30 to 40 mm above the level at which the first beats come through at the wrist the latter obviously representing the actual systolic pressure level This may be striking after exercise, leading to the erroneous diagnosis of hypertension if not checked by the palpatory method

Palpation likewise will protect the observer against the *auscultatory gap* of uncertain cause * There are occasional instances among persons with hypertension in whom sounds are heard for the first 20 to

* Berry has shown that the gap may be related to venous pressure in the arm He found that the gap was more prominent if the cuff is inflated with the arm in a dependent position and that it could be made to disappear by inflation of the cuff with the arm elevated Ragan and Bordley similarly showed that if venous distention distal to the cuff was eliminated by rapid inflation of the cuff the auscultatory gap was missing when the cuff was deflated Slow inflation of the cuff led to a gap subsequently

30 mm of mercury below the systolic pressure level This period is then followed by complete silence for a similar distance in millimeters after which there is a recurrence of the beats as before to go on to the diastolic level This silent area is the so called *auscultatory gap* The palpating fingers will be aware of beats throughout the silent period An example would be as follows systolic pressure 260 mm of mercury sounds present to the 230 mm level, then silence (auscultatory gap) to the 190 mm level recurrence of sounds to the change of diastolic pressure at the 130 mm level (The palpatory method is less accurate than the auscultatory method, since there is a lag of 10 mm or so between the hearing of the first sound and the feeling of the first beat The ear naturally is more sensitive than the finger)

Normal Blood Pressure Level The blood pressure is not of a constant level but subject to fluctuation at times quite marked even in a state of health * There is no universal agreement on which level is normal In general it may be said that healthy young persons have a systolic pressure of 100 to 120 mm of mercury and a diastolic pressure of 60 to 80 mm Normal persons of the asthenic or hyposthenic type are often found to have a constant hypotension—a systolic pressure of 90 to 105 mm of mercury and a diastolic pressure of 50 to 60 mm The upper limits for systolic and diastolic pressures in well persons should be set at about 140 and 100 mm respectively A systolic pressure above 140 mm is generally considered to be abnormal irrespective of age † (The rule of 100 plus age in years for normal pressure quoted all too often not only by lay persons but also by physicians is incorrect)

Pulse pressure is the difference between the systolic and the diastolic pressures and should be in the neighborhood of 40 to 50 mm of mercury

Variations in the systolic blood pressure level in healthy persons are easily understood since the pressure is related to blood flow and cardiac output on demand In sleep the systolic pressure is 20 mm or so lower than in the waking state Exercise may be the cause of a rise Emotion or excitement is commonly manifested by an eleva

* See page 497 Chapter 13 for the factors upon which arterial tension is dependent

† One cannot be too rigid about this however since with the progressive physiologic changes of age and loss of resilience in the vascular tree levels above 140 are commonly encountered in older persons who are apparently well

tion of the pressure Over the years, as I examined the first year medical students upon admission to medical school, 20 per cent showed a systolic pressure level of more than 140 mm It often required from two to four examinations to obtain a normal level This is an essential point to keep in mind in the evaluation of life insurance examinations, many an applicant has been turned down

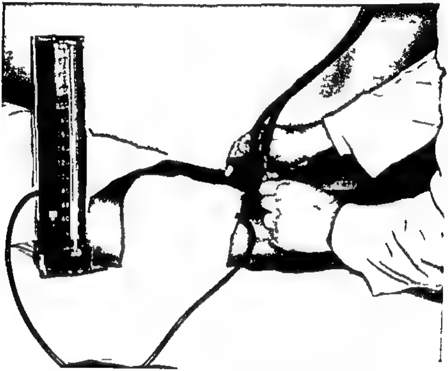

Fig 21 Determination of blood pressure in popliteal artery in prone patient by auscultatory method

because of an abnormal level upon the first examination The physician must remember the factor of excitement as he sees the patient for the first time in his office

The diastolic level changes less than the systolic one in normal persons The pulse pressure thus is increased owing to the systolic elevations noted above

The blood pressure should be taken in both arms at the first examination In the normal person a difference of 10 to 15 mm between the two arms is not uncommon a higher level being found more often in the right arm Anything above this differential should arouse suspicion in the mind of the examiner

Though the pressure in the brachial artery only has been discussed it is not the only point at which blood pressure can be determined It happens to offer the most convenient site The pressure in the lower extremity may be determined by placing a cuff about the thigh (a wider one may be necessary to circumvent certain technical difficulties discussed earlier) and by palpating and auscultating over the popliteal artery (Fig 21) Gravity is an important variable here (In the brachial artery when the subject is upright the pressure is as high as or higher than it is when he is in the recumbent position) When recumbent the brachial and femoral pressures are about equal though the latter is not infrequently the higher In the standing position the pressure in the femoral artery is greater than in the recumbent position because of the effect of gravity in terms of the column of blood This increase may be as great as 25 to 50 mm of mercury over the pressure in the prone position

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13. THE HEART AND BLOOD VESSELS—2

FINDINGS IN DISEASE

IN THIS CHAPTER, the application of the technics described in the preceding one will be discussed

Inspection

Posture In the early chapters of this book, attention was directed to the importance of posture and position assumed by sick persons At this point the student should be reminded that the patient with heart disease, if suffering from myocardial failure, almost always assumes an upright position to aid him in his respiratory discomfort The patient with congestive failure due to mitral stenosis often prefers to sleep sitting up with his head pillowed on his folded arms on a table or on the overbed table The child having congenital heart disease with cyanosis especially of the tetralogy of Fallot variety finds that a squatting position offers the most relief and maintains this position as a matter of choice (Fig 1)

Precordial Region As may be recalled inspection of the precordium in the normal person was useful only in the demonstration of the apical impulse, with such collateral evidence as the cardiac rate and rhythm Disease may cause both anatomic and physiologic change, and thus much may be revealed at the precordium

At first glance the *precordium* may be found to be more prominent than the corresponding area of the right chest wall—in fact, it may actually bulge, the surface being elevated a centimeter or more over that of the opposite side This usually means cardiac enlargement.

If hypertrophy developed in the first two or three decades of life, at a time when the chest wall is more elastic this bulging may be extreme A large pericardial effusion may be the cause also of prominence of the precordium

Fig 1 Position assumed by choice by patient having tetralogy of Fallot (note cyanotic lips)

Apical Region The *point of maximum impulse* may show one of several abnormalities Cardiac enlargement is the most common pathologic change altering the apex impulse Because of hypertrophy of the ventricles the apex impulse is displaced to the left and possibly downward With the right ventricular enlargement resulting from mitral stenosis the PMI may be displaced somewhat toward the left but remains in the fifth interspace In left ventricular hypertrophy instead of the normal position of the impulse within the midclavicular line in the fifth interspace commonly it will be displaced downward

to the sixth interspace In addition, there will be displacement laterally, which in extreme cases may even reach the midaxillary line Likewise, because of the left ventricular hypertrophy, the apex impulse is unlikely to be sharply localized and quick in character, appearing rather as a heaving impulse, rising and subsiding more slowly and representing an area of at least several centimeters in diameter In the presence of great enlargement, there may be systolic retraction of the interspaces between the displaced PMI and the sternum This occurs because of the decrease in the volume of the heart at the time of ventricular contraction, resulting in an increase in the negative intrathoracic pressure and thereby a falling in of the interspace

In the presence of a large pericardial effusion no PMI will be visible, the anatomic apex being separated too widely from the chest wall by fluid In lesser amounts of pericardial effusion the heart, floating in the fluid yet still in apposition to the chest wall may continue to show a PMI If adhesive pericarditis has occurred not only has symphysis of the visceral and parietal pericardial layers taken place but there may also be an adherence of the pericardium to the pleura of the overlying lung and to the chest wall As a result the interspaces of the precordium actually may be permanently retracted Even if this has not occurred a systolic retraction instead of an apical impulse is not uncommon (Broadbent s sign was originally described as a retraction of interspaces below the angle of the left scapula or in the posterior axillary line due to adhesive pericarditis involving diaphragmatic and pleuropulmonary structures Actually such retraction is seen at times in the presence of cardiac hypertrophy in persons of slight build for the same reason that precordial systolic retraction may occur as indicated in the above paragraph)

Extracardiac causes may displace the apical impulse from the expected site The most frequent of these is probably pleural effusion or pneumothorax If either fluid or air is present in considerable amount the heart will be displaced Air or fluid accumulations in the right pleural space produce less noticeable effects though the PMI may be shifted toward the anterior axillary line On the other hand left sided pleural fluid or air may shift the PMI to the left sternal border and even beyond the right sternal border In the presence of pulmonary atelectasis usually accompanied by a shift of

the mediastinum and its contents to the affected side displacement of the PMI will occur (Figs 15 16 18 pages 360 363) Displacement of the apex impulse by these extracardiac causes presupposes that there has been no previous mediastinal or pleural disease Antecedent inflammation which may have led to symphysis of the pulmonomediastinal pleurae or of the pleuropericardial structures may so immobilize the heart that even the high pressure of large accumulations of fluid or air in a pleural space may not be able to shift the apical impulse

Just as the pregnant uterus may displace the apex impulse upward and to the *left* so also may large abdominal tumors ascites and marked gaseous distention

Abnormalities of the position of the apical impulse are not unusual in the presence of advanced pulmonary tuberculosis or other pulmonary fibrotic disease With pleuropulmonary fibrosis retraction of the lung and pleuropericardial or pleuromediastinal adhesions displacement of the heart may occur Thus the apex impulse may be displaced in either direction dependent upon the side of the disease (Figs 14 25 pages 359 370)

In the presence of tumors of the superior mediastinum the heart may be pushed downward so that the PMI may be in the sixth or seventh interspace (Fig 2 page 343)

In the congenital anomaly of dextrocardia the apical impulse appears on the right side of the chest rather than the left

Diminution or absence of a visible apical impulse may occur under several circumstances As was indicated above pericardial effusion of considerable degree may be the cause of a decrease in or the absence of an impulse Diseases associated with myocardial degeneration and thus weakness of the muscle may account for a decreased or absent apex beat This may be met with in prolonged fever cachexia myocardial infarction shock and in heart failure The most common extracardiac disease causing an absence of a PMI is pulmonary emphysema Either in the hypertrophic or in the degenerative type of emphysema the lappet of lung overlying the heart may so bury the heart with distended air sacs and vesicles that no impulse can be transmitted to the chest wall

The character of the apex beat may be very suggestive of the type of disease present A comment was made above concerning the slow heaving, often rather diffuse, PMI of cardiac hypertrophy By contrast, the sharp, active quick thrust of the overactive heart (as appears in the normal subject under excitement or after exercise) is seen in the tachycardia of fevers, in thyrotoxicosis and in pain The impulse is weak under the circumstance in which there is lessened visibility of the apical beats, as was noted in the preceding paragraph The apex beat may be bifid, or double characterized by one impulse being immediately followed by another, slightly displaced from the first This is rarely seen, though bundle branch block, in which it occurs, is not too uncommon The conduction of the impulse to the ventricle, being delayed its contraction thereby lags behind the normal one to account for the bifid, or reduplicated impulse

Abnormalities of the rhythm of the heart beat may be quite obvious upon inspection of the apical beat Since the accuracy of diagnosis of the arrhythmias is much greater upon auscultation, the details of these will be considered under Auscultation later in the chapter However, in passing it should be pointed out that premature contractions (extrasystoles) and auricular fibrillation may be diagnosed merely by inspection of the apex beat Obviously, rapid and slow heart rates are likely to be quite evident

Hypertrophy of Right Ventricle The right ventricle presents anteriorly in the area of absolute cardiac dulness uncovered by lung Thus right ventricular hypertrophy may manifest itself by diffuse pulsation of the area to the left of the lower sternum

Basal Region The base of the heart also may be the site of abnormalities Anatomically, this is the region of the first, second and third interspaces between the parasternal lines Here may be encountered deviations from the normal due to disease of the great vessels or of the lungs

Prominence or bulging to the right or left of the sternum in the infraclavicular area may be indicative of a saccular aneurysm of the aortic arch this is more likely to occur on the right than the left side because of the more anterior position of the ascending arch Actual erosion of ribs may occur with the presentation of a pulsating mass (Fig 2) A sac of the transverse arch may push the upper sternum forward

Visible pulsation at the base of the heart in almost all instances means disease of the heart great vessels or lungs (The technics described under Inspection in Chapters 10 and 12 are applied in the search for pulsation) Aneurysm of the aortic arch is practically always associated with systolic pulsation visible in the chest wall over

Fig 2 Tumor of chest wall due to aneurysmal sac of ascending arch of aorta (From author s medical service Louisiana State University Medical School and Charity Hospital New Orleans)

lying the sac It may be sharply localized in an area of a couple of centimeters in diameter or may be present as a diffuse heaving pulsation of all of the infraclavicular area and a part of the mammary area as well as of the clavicles Or again it may be seen as a diffuse heaving pulsation of the first and of the upper part of the second portion of the sternum (As was noted in the discussion on exam

ination of the chest, pulsation in the left interscapular region may accompany saccular aneurysm of the descending arch)

Visible pulsation at the base of the heart may be encountered also in fibroid pulmonary disease Here the lungs may be retracted laterally to 'uncover' the base of the heart so that pulsation may be transmitted from the great vessels to the second and/or third interspace in the parasternal regions

Pulsation in the suprasternal notch is unusual except in disease Though it may be met with rarely in the overactive heart of excitement or exercise it is not uncommonly seen in thyrotoxicosis Usually, however, suprasternal pulsation means an abnormally high aortic arch Most commonly this is found to occur with arteriosclerosis of the aorta In arteriosclerosis, the aorta lengthens and uncoils, the arch thereby being pushed toward the upper border of the sternum The second most frequent cause of suprasternal pulsation is diffuse dilatation or saccular aneurysm of the aortic arch due to syphilis As was described in Chapter 8, an anomalously placed carotid artery or a sclerotic serpentine external carotid artery, especially on the right side, may be the cause of pulsation in the suprasternal notch

Other Regions Following a search for abnormalities in the precordial, apical, and basal regions of the heart inspection is directed for further evidence of cardiovascular disease In Chapter 8, it was indicated that abnormalities of the neck veins and arteries may be characteristic and even diagnostic of abnormalities of the cardiovascular system So too in the description of the examination of the chest, it was pointed out that the internal mammary and intercostal arteries may be enlarged to the point of presenting visible pulsation as part of the collateral circulation in coarctation of the aorta

Epigastric pulsation was mentioned in the last chapter as occurring under normal circumstances Rarely one may see pulsation in this area due to the pulsating liver of tricuspid valvular insufficiency or in the rare aneurysm of the abdominal aorta

PALPATION

Again it may be reiterated as in the previous chapter, that palpation in general confirms inspection, at times extending it to greater

diagnostic accuracy At times, however, palpation may reveal findings not visible

Precordial Region The palpating fingers or palm applied to the precordium may confirm fulness or bulging of the area The hand not only notes the displaced PMI in cardiac hypertrophy but may much more clearly reveal the diffuse heaving character of the impulse as the whole palm is lifted with the ventricular contraction It demonstrates the lack of a sharply localized impact against the hand as occurs in the normal person In pericardial effusion even though an impulse is not visible one may be felt at times weakly to be sure by the palm applied to the chest Palpation confirms the systolic retraction of an adherent pericardium

An invisible apex beat displaced by extracardiac disease may be felt and thus be of diagnostic aid

It was indicated under Inspection that the apical impulse not uncommonly may be diminished or absent Then palpation may be a valuable aid It may confirm the presence of a questionably visible apical impulse Of greater significance is the feeling of an invisible beat and noting its feebleness in myocardial weakness as is seen in shock myocardial infarction cachexia and with progressive fever So too the apex beat may be palpable even though the emphysematous lung may prevent its being seen

Changes in the character of the apex beat may be noted more readily by palpation than by inspection The feebleness or weakness of the impulse as it strikes the hand in myocardial disease has just been mentioned The palpating hand also is aware of the quick sharply localized impulse of thyrotoxicosis and of fever The rare bifid impulse of bundle branch block may be felt even better than seen

Arrhythmias of the cardiac beat may be much better evaluated by palpation of the apical impulse than upon inspection

Abnormal Pulsations Abnormal pulsations of the neck vessels of the suprasternal notch epigastrium and of the intercostal arteries may be confirmed or even diagnosed in the absence of visible pulsation by the palpating fingers

So too abnormal pulsations at the base of the heart due either to disease of the great vessels or to the retracted lungs baring the great

vessels, may be felt as well as visualized Furthermore, it is not unusual to demonstrate such pulsations even though invisible This is especially true if the patient is asked to hold the chest in the position of expiration (Fig 9, 10, pages 411 412) Many an aortic aneurysm is diagnosed only by palpable pulsation at the cardiac base

In addition to abnormalities of the apical impulse and the above pulsations due to disease, there are other palpatory findings not described in the last chapter, since they are not met with in normal subjects

Shocks A shock may be felt over a valve area at the base of the heart, and represents the accentuated heart sound as heard at the area with the stethoscope Thus valve shock is synchronous with closure of the valves It is felt as a short, sharp impulse If this valve shock is felt at the pulmonic area (second interspace to the left of the sternum), it represents closure of the pulmonary valve due to increased tension in the pulmonary circulation If felt over the aortic valve area to the right of the sternum it indicates increased tension in the greater circulation A *diastolic shock* may be felt at times over a saccular aneurysm of the aortic arch

Thrills A thrill is produced when fluid (blood) flowing through a smooth structure (artery or valve orifice) moves into an area of changed caliber whether widened narrowed or irregular The resulting turbulence produces vibrations which are transmitted to the palpating hand as a series of impulses and when heard with the stethoscope represent a murmur * (All thrills have a concomitant murmur

* This basic cause for the production of a thrill (palpation) or murmur (auscultation) can be easily understood as a simple fact in everyone s experience As one walks along the banks of a small stream one may observe the following Where the water flows between smooth parallel banks the flow is soundless As one walks farther a boulder may be found embedded in the bank This narrows the bed of the stream and imposes an obstruction to the flow of water Eddy currents form around the boulder and if one listens rippling sounds are heard Similar eddy currents may be produced by a narrowed heart valve or coarctated aorta hence palpable vibrations as a thrill or audible ones as a murmur As one walks farther along the stream though the width is unchanged one may come to a rapids Here because the water flow is broken up by rocky irregularities sound is again produced (So too the smooth flow of blood may be broken by a roughened valve or by atheromatous or calcified plaques in the supravalvular aortic segment with again the production of a thrill and/or murmur) At one place the soundless stream widens suddenly at such a point ripples occur (Such ripples or eddies explain the murmurs set up when blood enters a chamber or vessel from a narrowed structure as blood flowing into a dilated ventricle or through the aortic ring into a dilated aorta)

The reverse is not true however since most murmurs are either too faint or have a sound frequency too high to be appreciated by tactile end organs) (Classically the thrill has been compared in textbooks to the sensation obtained when a hand is placed on a cat s throat during purring) The examiner must note *the site* of the thrill, and it is especially essential to identify its place in the cardiac cycle More will be said of thrills in the discussion of abnormal cardiac findings

A thrill is encountered most frequently in *mitral stenosis* This will be felt to be sharply localized in the fourth or fifth interspace, most often at a site medial to the midclavicular line Since it is produced by blood flowing from the auricle into the ventricle over or through a firm rough mitral valve which cannot open fully the thrill is diastolic in time In *aortic stenosis* the thrill is systolic in time because it is produced as blood is being ejected into the aorta through a narrowed firm semilunar valve It is usually felt at its maximum in the second interspace to the right of the sternum and is often transmitted upward toward the neck and carotid artery In *congenital defects* a systolic thrill is usually present with pulmonic stenosis in patent ductus arteriosus it may be continuous though ac centuated or more prominent in systole In the former the point of maximum intensity will be at the left second interspace to the left of the sternum In the latter the thrill is over the sternum and in the third left interspace Thrills may occur in saccular aortic aneurysm coarctation of the aorta and other rather infrequent cardiovascular lesions A thrill is present also in very rare clinical entities as rupture of the interventricular septum following myocardial infarction and ruptured chordae tendoneae (See the illustrations ac companying the descriptions of murmurs later in this chapter)

Friction fremitus was described in the chapters on the chest and

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Below the rapids the stream again may be soundless between smooth banks Then a sharp curve appears and ripples form on the lesser bend (Thus a kinked or distorted blood vessel may have accompanying eddies felt as a *thrill* or heard as a *murmur*) Farther on as the stream is followed one finds that newly formed sandbars contain the stream but water stands behind them with one passage through the bar con necting with the stream proper Water flows through this opening with audible eddies (Similarly blood flows from the aorta through the opening into an aneurys mal sac or through an arteriovenous fistula to produce eddies palpable as a thrill or heard as a *murmur*) If the student will follow such a stream the thrills and murmurs will not be mysterious intangible physical phenomena but rather readily understood facts easily interpreted in terms of pathology

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Abdominal distention due to ascites tumor or gaseous distention of the bowel may displace the heart upward and to the left, just as does the gravid uterus late in pregnancy with an increase in the area of cardiac dulness This displacement is mediated through upward pressure upon the diaphragm As it is pushed upward, the heart is

Fig 3 Heart in rheumatic mitral stenosis Prominence of right heart border results from right heart hypertrophy Left border is straight or slightly convex in upper segment because of prominence of pulmonary artery and dilated left auricle

partially rotated thereby moving its left border laterally and thus simulating enlargement

It is in disease mainly that the right cardiac border may be percussed Right heart enlargement may result in dulness on percussion from 2 to 3 cm to the right of the midsternal line This is mainly in the lateral direction Then as the border swings downward and medially it forms an acute angle with the line of hepatic dulness (Fig 3)

lungs At this point attention is directed to inflammation of the pericardial or pleuropericardial surfaces The palpatory sensation for the examiner is the same as that described in the discussion on pleural friction in Chapter 11 However in pericardial or in pleuropericardial disease, the to and fro characteristic is related to the cardiac rather than to the respiratory cycle

Friction rubs in the pericardium commonly arise from the fibrinous inflammatory processes of rheumatic pericarditis less often in tuberculous and pneumococcic pericarditis and still less often in other bacterial infections Not infrequently a friction rub develops after coronary occlusion fibrin having been deposited over the myocardial infarct thereby producing a palpable friction rub if the anterior cardiac surface is involved Friction rubs also commonly occur in uremia because of fibrinous deposits on the pericardial surfaces In the rare instances in which lymphomas or other tumors involve the pericardium a rub may develop over the neoplastic growth

PERCUSSION

By this technic, examination may demonstrate abnormalities of the supracardiac area (great vessels) or of the cardiac dulness either in size or in contour

Increase in Cardiac Dulness This is the most frequent abnormality, and in almost all instances it represents cardiac enlargement As was indicated under Inspection and Palpation, enlargement of the heart displaces the PMI and obviously therefore the left border to the left The displacement is truly lateral if due to right heart enlargement and has a downward component as well if due to left heart enlargement In the former then the contour of relative dulness is likely to be extended laterally in the third and fourth interspaces especially (Fig 3) In the presence of left ventricular hypertrophy the enlargement is downward as well as is shown by the lateral displacement of the left cardiac border in the fourth, fifth, and sixth interspaces This may reach to the anterior axillary or even to the midaxillary line Such a contour without lateral displacement in the third interspace produces a so called boot shaped heart (Fig 4) Occasionally, if there is dilatation of the left auricle dulness may be demonstrated in the second left interspace (Fig 3)

Extrinsic causes of increased relative cardiac dulness may be several *Pleural effusion* on the right side may displace the mediastinum and the contained heart to the left, thereby apparently increasing the area of cardiac dulness Left sided pleural effusion makes

Fig 5 Cardiac shadow in presence of large pericardial effusion

impossible the outlining of cardiac dulness However, in displacing the mediastinum to the right an area of right heart dulness may be produced In great effusions in the left pleural space almost all of the heart may be displaced to the right of the midline giving rise to an area of right cardiac dulness never encountered in right sided hypertrophy Pneumothorax of sufficient degree to displace the mediastinum may have the same effect as pleural effusion The apparent increase of the area of cardiac dulness is to be explained by the shift of the heart Because of the shift of the mediastinal contents to the side affected in instances of pulmonary atelectasis cardiac dulness is increased on that side (Figs 15 18 pages 360 363) Consolidating disease of the left lung with attendant dulness adjacent to the heart

Pericardial effusion is a much less common cause of an increase in the area of cardiac dulness than is enlargement of the heart When the effusion is considerable, it tends to produce a triangular area of dulness with its apex at about the second interspace The dulness

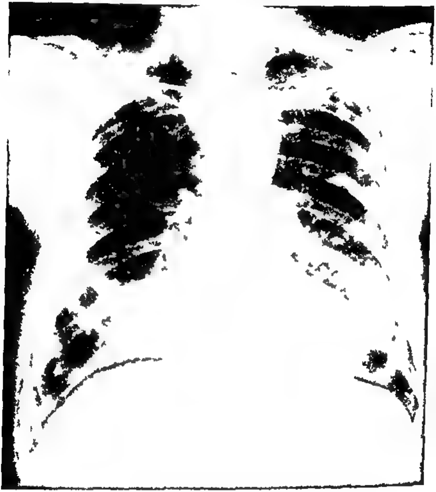

Fig 4 Heart in aortic insufficiency Boot shape results from left ventricular hypertrophy

then will extend downward to the sixth interspace and the percussed cardiohepatic angle probably will be obtuse Relative cardiac dulness will be replaced by absolute dulness because the lung has been displaced laterally by the distended pericardial sac (Fig 5) (Great pericardial effusion compresses the lung to such a degree that dulness and bronchial breathing may be demonstrable in the region of the lower angle of the left scapula—Ewart s sign)

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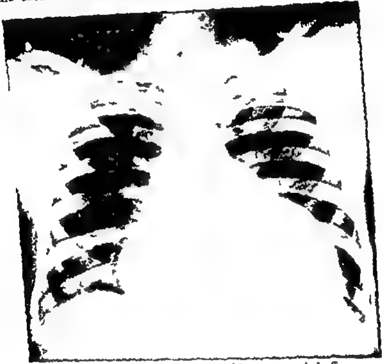

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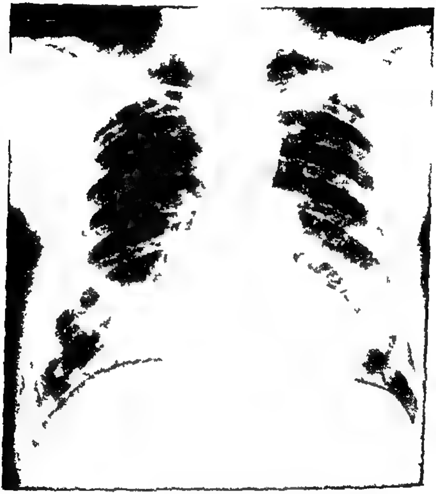

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Auscultation

In applying auscultation to the diseased heart attention is directed to the heart sounds to the presence of abnormal sounds especially of murmurs and less commonly to friction rubs Lastly the examiner must try to analyze any arrhythmias which may be apparent

ABNORMALITIES OF THE HEART SOUNDS

In the previous chapter it was pointed out that the normal sounds are described in terms of (1) quality (2) pitch (3) intensity and (4) duration The intensity of the sounds will attract the beginner first

First Sound *Increased Intensity* Increased intensity of the first sound will be found in a number of clinical conditions

Tachycardia is often accompanied by an increased loudness of the sound The most common examples will be found among the fevers of infectious origin The sounds will be found to be shorter than normal quick and loud Another disease entity also accompanied by increased blood flow is thyrotoxicosis Here the heart sounds are like those of the fever patient Again the quality is that of a short or quick loud sound the duration of the sound is shorter because the tachycardia must be accompanied by a shortening of the cycle

Cardiac hypertrophy (ventricular) before myocardial failure ensues may lead to a change in the heart sounds The intensity may be increased that is the sounds are louder owing to the contraction of the hypertrophied muscle with increased force They may be of a booming or reverberating quality

In *mitral stenosis* the first sound in which the characteristic crescendo murmur ends is accentuated in intensity and has a snapping quality The exact cause of this is unknown though a number of factors might theoretically explain this as suggested by Levine In the presence of heart failure this accentuation may be lacking

Decreased Intensity Decreased intensity of the first sound may be indicative of serious cardiac disease and is usually to be accounted for by myocardial changes interfering with the normal contractility of the myocardium

may cause *apparent* increase in the cardiac dulness Such consolidation may be either inflammatory or neoplastic Fibrotic retraction of the portion of lung overlying the heart 'uncovers it, and thereby certainly increases the area of absolute cardiac dulness, and usually extends the area of relative dulness to the left because of more accurate percussion

Mediastinal tumors, solid or as an aneurysmal sac, may extend the cardiac dulness and change its contour in the left third or fourth interspaces, or may be the cause of dulness to the right of the sternum in the third interspace The most common percussion abnormality of such lesions is in the production of an area of *supracardiac* dulness This is percussion dulness in the first and second interspaces retrosternally and lateral to the sternum to either or to both sides, the contour and lateral extent of dulness varying with the size and contour of the tumor (Fig 2 page 343)

Decrease in Cardiac Dulness (Under the discussion of the normal heart, it was noted that gastric tympany may be so prominent as to prevent the demonstration of the normal area of cardiac dulness) The most common pathologic cause of decreased dulness is pulmonary emphysema It is not uncommon either in the elderly patient or in the younger patient with chronic asthma to find such distention of the pulmonary alveoli or air sacs that the lung overlying the heart actually buries the heart to the depth of several centimeters Such a hyperresonant barrier may preclude the demonstration of any cardiac dulness whatsoever Lesser degrees of emphysema prevent the accurate mapping of the left border of cardiac dulness Only several centimeters of dulness may be found to the left of the sternum where the overlying lappet of emphysematous lung thins out

Pneumothorax obliterates the area of cardiac dulness because of the air lying between the heart and the chest wall So too in the extremely rare instances of pneumopericardium a similar situation would exist

Dextrocardia In the rare instances of congenital dextrocardia the cardiac dulness on the right side is a mirror image of that expected on the left side The apex impulse on the right would also be comparable to that expected upon the left side in normal circumstances

pulmonary circulation and is therefore characterized by accentuation of the pulmonic second sound (Fig 13) *Left ventricular failure* of whatever cause likewise causes an increased burden on the lesser circulation by back pressure and thereby may account for intensification of the pulmonic second sound In certain types of congenital heart disease accentuation may occur also

Pulmonary disease attended by an increase in the pressure in the pulmonary circulation is not uncommon Examples of this are emphysema pulmonary fibrosis and pulmonary infarction by embolism—all characterized before failure of the right heart occurs by an intensified pulmonic second sound

ACCENTUATION OF AORTIC SECOND SOUND This change may be due to two causes

Hypertension in the greater or systemic circulation obviously will snap the semilunar valves shut with greater force and is the most common cause of an accentuated aortic second sound

Aortic disease either syphilitic or arteriosclerotic may be characterized by an accentuated second sound at the aortic area This occurs because of the loss of aortic elasticity which normally absorbs some of the systolic pressure In both conditions the ascending arch of the aorta may be closer to the anterior chest wall as an additional factor in the intensification of the second sound

Decreased Intensity Decreased intensity may also occur in disease

WEAKNESS OF PULMONIC SECOND SOUND This may be indicative of right heart failure with lessening of the pressure in the pulmonary circulation It is especially serious if it occurs following previous observations of an accentuated pulmonic second sound The second sound at the pulmonic area is also of a lesser intensity or absent in the presence of *pulmonary stenosis* at or proximal to the valves

WEAKNESS OF AORTIC SECOND SOUND A weak aortic second sound is encountered when there is a decrease of tension in the systemic circulation *Hypotension* of whatever cause—left *ventricular failure* or *peripheral circulatory failure*—is characterized by a decreased aortic second sound In *aortic insufficiency* of high grade inadequate closure of stiffened valve cusps offers insufficient resistance to the intra aortic blood pressure to produce the intensity of the usual degree

Prolonged infection especially associated with fever, as found in typhoid fever or in prolonged malaria, may eventually lead to myocardial degeneration This causes an alteration of the first sound The sound often is shorter, and gives an impression of weakness," since it is not clearcut and sharp Commonly, this weaker sound is described as a 'muffled' first sound In extreme cases, the sound may be almost inaudible or may give the impression of being heard at a distance

Cardiac failure is commonly accompanied by a change in the intensity of the first sound Above it was noted that the hypertrophied ventricle causes accentuation of the first sound However, as the myocardium fails and as increasing dilatation occurs the first sound becomes weaker in intensity, as described in the preceding paragraph

Myocardial infarction in a like manner will lead to comparable changes in the first sound

In all of these instances if the student will recall the findings at the autopsy table—that is, the dilated ventricle and/or the flabby myocardium of prolonged fever and of coronary artery sclerosis—he can well understand the changes in the first sound The decreased intensity is an expression of a diminution in the force of closure of the auriculoventricular valves resulting from a weakened ventricular contraction Therefore the first sound is not only weaker but of shorter duration at times closely approaching the quality of the second sound With tachycardia such a first sound in conjunction with the second sound suggests a "tick tock rhythm the sounds being almost equal The term embryocardia' is used for this type of first heart sound This is usually a situation of grave import

A decrease in the intensity of the first sound at the apex is commonly accompanied by a complete absence of the first sound at the base

Second Sound *Increased Intensity* Increased intensity of either pulmonic or aortic second sounds or both may be present in disease

ACCENTUATION OF PULMONIC SECOND SOUND This results from any condition which increases the pressure in the lesser or pulmonary circulation and thereby closes the semilunar cusps of the pulmonic valve with greater force

Mitral disease especially stenosis produces back pressure on the

of the asynchronous ventricular contractions as noted above, obviously may be carried over to asynchronous closure of the valves at the base More commonly reduplication at the base is due to increased tension in either the systemic or the pulmonary circulation the greater pressure causing an earlier or quicker closure than in the

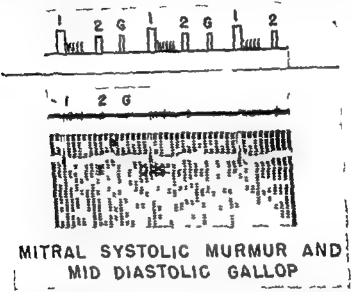

Fig 6 Stethogram illustrating third heart sound (G)—diastolic gallop rhythm (mitral systolic murmur is shown in stethogram and diagrammed following first sound (1))

opposite valve (The best example is that encountered in well marked mitral stenosis The increased pressure within the pulmonary circulation accounts for the splitting of the second sound—asynchronous closure of the valves at the base)

Gallop Rhythm An extra sound appearing in the cardiac cycle may give rise to a rhythm suggestive of a horse galloping (In the previous chapter it was pointed out that the third heart sound commonly heard in normal young persons may suggest gallop rhythm) In this chapter we are dealing with gallop rhythms usually indicative of serious disease Gallop rhythm can be clearly recognized and timed only if the rate is moderately slow Only diastolic gallop rhythms are heard with any frequency and are of clinical and prognostic

In *aortic stenosis* the valves may be so immobile that a sound cannot be produced

Diminished intensity of the second sound at the base is commonly reflected in an absence of the second sound at the apex

Extracardiac Disease and Heart Sounds The foregoing discussion of variations in heart sounds was given over to intrinsic cardiac disease or changes in the circulation Variations in the intensity and character of the heart sounds may be due to extracardiac causes which may apply to either or both the first or second sounds as heard at the apex or at the base

Accentuation of Sounds If the portions of the lungs normally overlying the heart are retracted, by fibrosing pulmonary disease or by pleural adhesions the heart is thereby brought into closer apposition to the chest wall Naturally, the heart sounds then are little modified by air containing lung, and thus are more intense This may be true at either the base or the apex of the heart A tension pneumothorax because of its excellent resonance, may intensify the heart sounds

Diminution of Sounds The heart sounds are commonly found to be decreased, distant or even absent in pulmonary emphysema The heart may be so surrounded by the ballooned lung tissue that the cardiac sounds are transmitted poorly or not at all

So too the presence of varying amounts of fluid in pericarditis may cause diminution or even absence of the heart sounds

Reduplication of the Heart Sounds In the chapter on examination of the normal heart reduplication (splitting) of the first and second sounds was mentioned as occurring not uncommonly in young subjects especially Reduplication may also be a feature of pathologic states

First Sound Reduplication of the first sound is found in myocardial disease of such nature that normal conduction is interfered with and as a result there is asynchronous ventricular contraction with consequent asynchronous valvular closure This is seen at its best in bundle branch block or intraventricular block which is commonly caused by myocardial infarction It may also be found in auriculoventricular block and after heart failure appears in mitral stenosis

Second Sound Asynchronous closure of the pulmonic and aortic valves may be due to the effects of bundle branch block The effects

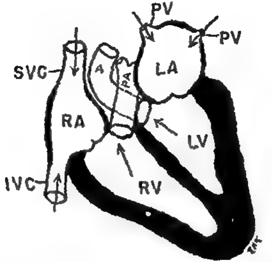

Fig 7 Schematic illustration of normal heart in systole Blood is entering right (RA) and left (LA) auricles from superior (SVC) and inferior (IVC) vena cavae and from pulmonary veins (PV) respectively Mitral and tricuspid valves are closed Right (RV) and left (LV) ventricles are ejecting blood into pulmonary artery (PA) and aorta (A) respectively

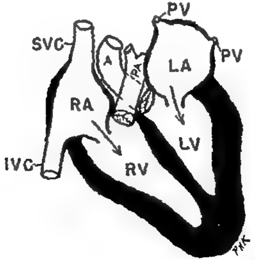

Fig 8 In diastole mitral and tricuspid valves are open to permit blood to flow into ventricles with aid of auricular contractions Aortic and pulmonic valves are closed

significance, a systolic gallop, rarely encountered, may be disregarded

The recognition of the diastolic timing of the third sound causing the gallop rhythm will be sufficient for the student (Fig 6) Levine points out that the designations of *protodiastolic mesodiastolic* and *presystolic* are confusing These terms point to the time in diastole at which the abnormal second sound appears, namely, early in the middle and late in diastole

A diastolic gallop rhythm usually has serious meaning being indicative of grave myocardial disease It is most often met in coronary artery and hypertensive heart disease Levine believes the third heart sound, accountable for the gallop is due to sudden movement of the auriculoventricular valves This may be protodiastolic owing to sudden flow of blood from the auricle to the ventricle the pressure in the latter being zero, it may be presystolic at the time of auricular contraction because of a more sudden flow of blood through the valves The increased residual blood in the heart chambers may account for the accentuation of an otherwise normal process

Slowing of auriculoventricular conduction in rheumatic carditis may permit a relatively early auricular contraction whose sound then may suggest a diastolic gallop rhythm Early in the development of the murmur of mitral stenosis its mid diastolic appearance may simulate a diastolic gallop rhythm Furthermore, the opening snapping sound encountered in mitral stenosis may cause a third sound, protodiastolic in time

MURMURS OF PATHOLOGIC ORIGIN

The preceding chapter contains a discussion of *physiologic* murmurs as heard at times in the normal person Here we will concern ourselves with *pathologic* murmurs Textbooks commonly explain the physics of murmur production by a mechanical alteration of blood flow through a rubber tube I have preferred to use the simple example of the sounds one may hear in walking along a flowing stream as described on page 448 This is within everyone s experience and well illustrates the mechanics of the production of murmurs in the cardiovascular system

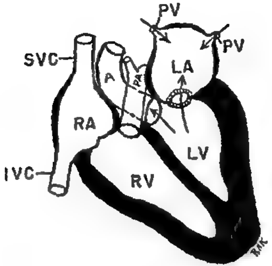

Fig. 9 Schematic illustration of mitral insufficiency Blood flows back into auricle at same time blood moves into aorta during systole

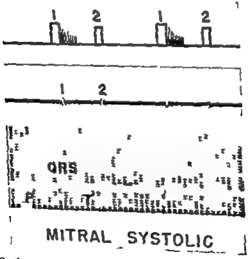

Fig. 10 Stethogram showing first sound at (*1*) followed by systolic murmur (block diagram shows relationship of *mitral* systolic murmur of insufficiency to first sound it follows it immediately)

For the adequate description of murmurs as was indicated in the foregoing chapter, certain features must be noted These are

1 Place in the cardiac cycle
2 Duration
3 Site and radiation
4 Pitch
5 Quality
6 Intensity
7 *Effect of position* exercise, *respiration*

1 The place of the murmur in the cardiac cycle can usually be accurately determined by identifying the first and second sounds either by observation or palpation of the apex beat or by palpation of the carotid artery Timing becomes increasingly difficult and even impossible in the face of tachycardia and in certain arrhythmias (For comparative purposes with subsequent illustrations Figs 7, 8 are included to remind the student of the position of the valves and direction of blood flow in the normal heart in systole and diastole)

2 The length or duration of a murmur is related to the proportion of the cardiac cycle which it occupies

3 The site of the maximum intensity of the murmur is usually at the valve area representing the source of the murmur (This is not always true as will appear later since the maximum intensity may be in the area of radiation) The radiation or propagation of the murmur is commonly in the direction of blood flow

4 The pitch of a particular murmur may be characteristically either high or low for example mitral systolic murmurs are always of a higher pitch than those of mitral stenosis

5 The quality as noted before is often expressed in terms of roughness of a rumbling type whistling or blowing type etc

6 Intensity varies not only with types of murmurs *but also in persons having* an identical type of heart lesion Furthermore the intensity of a murmur may show an increase or decrease during its course which may be quite characteristic of certain murmurs *Thus a murmur may be described as being crescendo or* diminuendo (decrescendo) respectively Loudness also depends to a certain extent upon the condition of the heart muscle For example murmurs diagnostic of valvular disease may disappear as heart failure ensues to reappear with the reestablishment of compensation

7 Diagnostic importance may be attached to the alteration *in murmurs* brought out by change in position by exercise or by respiration

Pathologic Murmurs Originating from Valvular Deformity In this category, we will consider murmurs caused by alterations of the valve leaflets or cusps by inflammatory or other disease * *Rheumatic fever* and syphilis are the two inflammatory diseases accounting for the greatest proportion of these murmurs

* *Some textbooks* list these as "organic"

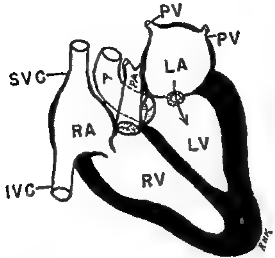

Fig 12 S hematic illustration of blood flow from auricle through narrow valve of mitral stenosis during diastole

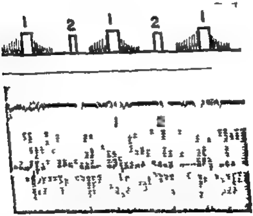

Fig 13 Stethogram showing murmur just preceding and following first sound (1)—mitral stenosis and insufficiency Second sound (2) is accentuated (Block diagram illustrates diastolic murmur ending in snapping first sound and decrescendo type of systolic murmur)

Mitral Valve Murmurs Rheumatic fever is by far the most common inflammatory disease which affects the mitral valve Much less frequently, the vegetations of subacute bacterial endocarditis of acute endocarditis of the septicemias, and of disseminated lupus erythema

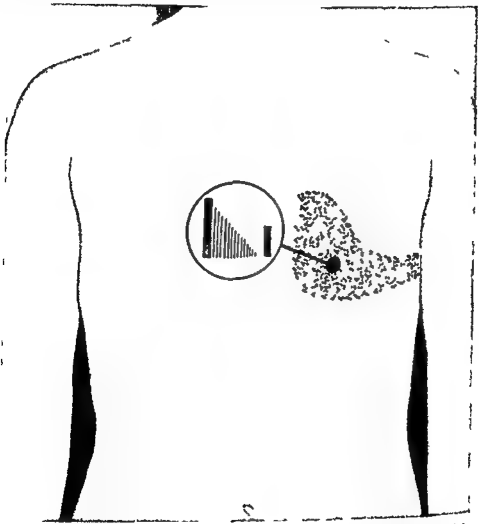

Fig 11 PMI of systolic murmur of mitral insufficiency is indicated by solid area wide radiation is shown by stippled area encircled diagram illustrates decrescendo character and extension through most of systole

tosis may produce the murmurs to be described Of course the first of these occurs usually on a valve already damaged by rheumatic disease The student will possibly never see the rare instance in which tumors, usually metastatic to the heart may produce deformity of the valvular orifice

stenotic valve under greater pressure The crescendo rumble ends in a loud and often snapping first sound

Position is important in the analysis of this murmur It is heard commonly only in the supine position and in some instances only

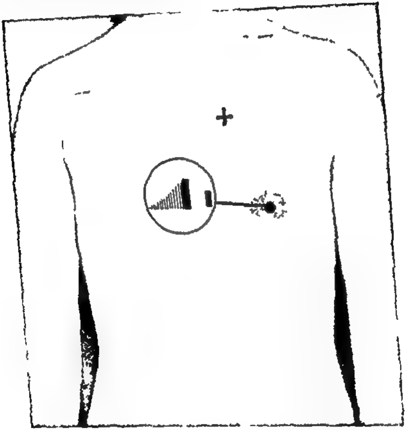

Fig 14 Sharply localized murmur of mitral stenosis is indicated by solid area with limited radiation (stippled area) Accentuated pulmonic second sound is indicated by cross Encircled diagram illustrates crescendo character of murmur

when the patient turns toward his left side A faint suspicious rumble often may be clearly intensified when the patient assumes the left lateral decubitus The murmur often disappears in the erect position (Thus the student must realize that examination of the heart is not complete when the patient is in the erect position only) Exercise

MITRAL INSUFFICIENCY If rheumatic infection has so altered the valve leaflets that closure is incomplete at systole, a stream of blood will regurgitate backward through the defective valve to the auricle Since this is at the time of ventricular contraction, it will produce a systolic murmur (Fig 9)

It appears early in systole, extending well to midsystole, and often throughout it (Fig 10) The murmur is usually heard at its best at the mitral area with radiation laterally to the axilla but also upward over the precordium (Fig 11) It is high pitched The quality is usually of a blowing character, though it may be whistling or harsh Intensity of the murmur is variable, since it may be soft or loud usually, however, being quite prominent The murmur does not disappear with change of position, exercise may intensify it, its intensity changes with the respiratory cycle only so far as the distended lung in inspiration may decrease its loudness

MITRAL STENOSIS Not only may the rheumatic inflammatory deformity of the mitral valve leaflets prevent closure, but by the thickening and scarring it may also cause great narrowing of the valvular orifice Such valvular stenosis is made evident by a very characteristic, diagnostic murmur Since it occurs as blood is flowing from the auricle to the ventricle it is diastolic in time (Fig 12) It may appear in mid diastole only Usually, it continues with increasing force throughout the latter part of diastole to end in the first sound, since the atrium contracts to its maximum degree during this time* (Fig 13) The murmur is usually very sharply localized at the apex, so much so that at times the stethoscope bell covers the area in which it is heard In some instances, the murmur may be lost even though the bell is moved only 2 or 3 cm (This indicates the careful search necessary at times in diagnosis) There is no radiation of the murmur (Fig 14)

The murmur of mitral stenosis is low pitched and of a rumbling quality Its intensity is low but very commonly, as indicated above it has an increasing intensity, or crescendo tendency This is due to the atrial contraction in late diastole forcing the blood through the

* Uncommonly a diminishing or decrescendo murmur appears early in diastole This occurs because there is high pressure in the atrium as the ventricle relaxes at the end of systole and thus the first blood coming from the atrium is ejected with greater force

such as sitting up and lying back a dozen or so times or hopping up and down followed by examination in the recumbent position, may intensify or bring out the rumbling diastolic murmur Respiration influences it only so far as it does the systolic mitral murmur With

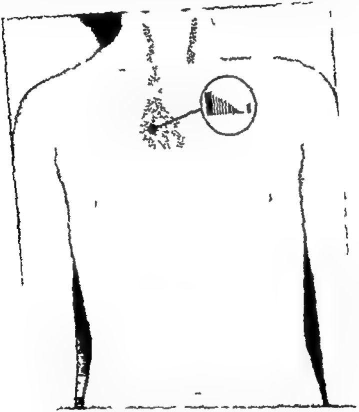

Fig 17 PMI of murmur of aortic stenosis is shown by solid area in right second interspace Local radiation and that to carotid areas in indicated by stippled areas Decrescendo murmur is diagrammed within circle

the onset of *auricular fibrillation* the diastolic murmur occasionally is lost but more commonly is altered being heard early in diastole as a diminuendo rumble With loss of atrial contraction maximum blood flow through the mitral valve occurs immediately following ventricular systole This is not necessarily true however It is in mitral stenosis that a thrill is most commonly felt as was described earlier in the chapter

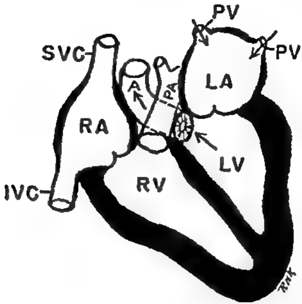

Fig 15 Schematic illustration of blood flow through stenotic aortic valve during systole

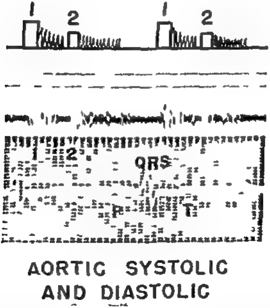

Fig 16 Stethogram recorded at aortic area Decrescendo character of systolic murmur following first (*1*) sound as well as prolonged diastolic regurgitant murmur after second (*2*) sound is well shown (Block diagram shows both murmurs and their relationship to heart sounds)

of the valve leaflets vegetations of bacterial endocarditis or a congenital anomaly a bicuspid valve which has a tendency to undergo sclerosis (All of these may interpose a partial obstruction to the smooth flow of blood from the ventricle just as the boulder at the edge of the smooth flowing stream mentioned earlier in the chapter, causes ripples) The first two of these causes are the most frequent

The murmur of aortic stenosis is obviously systolic in time since it is produced as blood is forced into the aorta by the contracting ventricle (Figs 15 16) It is heard best at the aortic area (in the second interspace to the right of the sternum) and is transmitted along the route of blood flow—upward to the arteries of the neck and upper arms (Fig 17) The intensity is greater because of the high pressure in quality it is harsh or rough The murmur is loud easily heard being decrescendo since the pressure is dropping toward the end of systole The murmur is not influenced by position exercise or respiration

A *thrill* commonly accompanies the systolic murmur at the aortic area and also in the neck arteries

AORTIC INSUFFICIENCY If closure of the aortic valve is incomplete a murmur will be produced This is due to a regurgitant flow of blood backward through the incompetent valves into the ventricle (Fig 18) Syphilitic valvulitis dilatation of the aortic ring and of the ascending aorta due to syphilitic aortitis and rheumatic valvular disease are the most common causes of aortic insufficiency Less commonly the vegetations of bacterial endocarditis or arteriosclerotic valvular changes may be a cause as in the case of aortic stenosis Rarely there may be a traumatic rupture of a cusp resulting in incompetency

The murmur of aortic insufficiency is early diastolic in time appearing just after the second sound (Fig 16) In free regurgitation it commonly lasts throughout diastole It is heard best at the aortic area and or at the left edge of the sternum in the third interspace (Erb s point) The murmur radiates in the direction of the regurgitant stream—that is downward toward the apex—and is often heard the whole length of the heart from the aortic area along the left of the sternum to the apex of the hypertrophied ventricle in the midaxillary line (Fig 19)

Tricuspid-Valve Murmurs Deformity of the tricuspid valve leaflets is rare, and therefore few are the instances of organic tricuspid murmurs in the experience of any physician Since the etiologic and mechanical bases are the same for both the mitral and tricuspid valves, the comments made with regard to the former may be carried over to the latter The site of the murmurs only will vary

The murmurs of *tricuspid insufficiency* and *tricuspid stenosis* are heard at the tricuspid area in the fifth interspace at the left border of

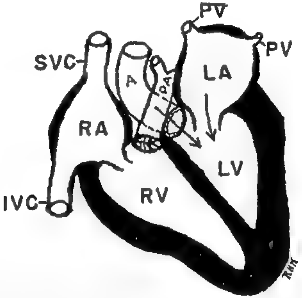

Fig 18 Schematic illustration of regurgitant flow from aorta in diastole because of aortic valvular incompetency (Anterior cusp of mitral valve is caught between two streams of blood shown by arrows Large regurgitant stream might displace mitral cusp to partially obstruct atrioventricular ring—relative mitral stenosis manifested by diastolic Austin Flint murmur)

the sternum A thrill may accompany the stenotic lesion If the question of a tricuspid valve lesion arises, collateral clinical evidence (see page 450) may be of diagnostic assistance

Aortic-Valve Murmurs Second in clinical frequency to murmurs originating at the mitral valve are those at the aortic valve

AORTIC STENOSIS This denotes a narrowing of the aortic orifice so that the passage of blood under pressure from the contracting ventricle gives rise to vibrations or turbulence to be heard as a murmur The narrowing may result from the firm scarred valve of rheumatic infection atheromatous or calcific arteriosclerotic plaques

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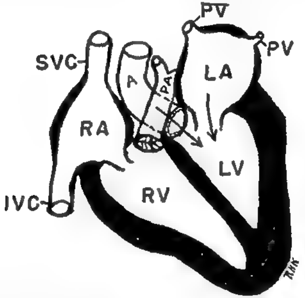

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PULMONIC INSUFFICIENCY Valvular deformity causing incompetency is rare If it occurs it is most commonly due to congenital anomalies of the valve cusps and infrequently due to inflammatory disease In high grade lesions of mitral stenosis the pressure in the pulmonary circulation may be so great that during congestive failure there is a relative pulmonic incompetence (dilatation of the pulmonary artery) The characteristics of the murmur are the same as of that of aortic insufficiency except that its maximum intensity is at the pulmonic area with transmission along the left of the sternum *

From the foregoing discussion it is apparent that diastolic murmurs heard at the mitral or aortic area are the ones of greatest significance as an index of valvular disease These murmurs make up the great majority of the pathologic murmurs due to valvular disease The systolic murmur of aortic stenosis is uncommon and organic murmurs of the tricuspid and pulmonic valves are rare

Pathologic Murmurs Originating from Nonvalvular Disease In this category will be placed a number of well known common murmurs They are due not to disease of the valve leaflets or cusps themselves but to changes of the valve ring or of adjacent structures or to abnormal blood flow They may in some instances give rise to murmurs very suggestive of those produced by valvular deformity Since they are not due to valvular disease as such the term functional has been applied by many authors However since this term is also commonly used in describing the physiologic murmurs discussed in the preceding chapter I find that this term has led to much confusion in the minds of our students Therefore I prefer to use the term relative in this group of murmurs

Mitral Murmurs RELATIVE MITRAL INSUFFICIENCY Because of left ventricular dilatation with or without hypertrophy the mitral ring is increased in its diameter preventing complete closure by the unaffected mitral valve leaflets Furthermore because of the dilatation the papillary muscles move away from the valvular level and thereby cause a relative shortening of the chordae tendineae which also is a factor preventing approximation of the leaflets These changes are en

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* The differentiation between aortic and pulmonic incompetency may be difficult on the basis of the murmur at the left border of the sternum alone The collateral signs of aortic incompetency to be described later in the chapter are of aid

The murmur is relatively high pitched and of a blowing quality The intensity may be soft or faint or quite loud It is decrescendo because the intra aortic pressure falls somewhat and ventricular pressure rises later in diastole Position may be helpful in bringing out faint murmurs of aortic insufficiency The regurgitant murmur is often heard best with the patient in a sitting position and leaning forward a bit (Fig 10, page 412) This will intensify or actually bring out murmurs not heard in the recumbent position Exercise does not affect the murmur Respiration is important only so far as it covers up a faint, early diastolic blow Having the patient sitting upright and holding his breath in expiration will be of aid in bringing out the murmur of aortic incompetency * The patient even may be asked to get up on his hands and knees in an effort to bring out this murmur

Much less frequently the diastolic murmur has a musical quality which has been described as cooing or been called a sea gull murmur Such a quality is more likely to occur in syphilitic aortic regurgitation than in the other kinds It is especially characteristic of traumatic aortic insufficiency

Pulmonic Valve Murmurs Though *physiologic murmurs* are heard not infrequently at the pulmonic area, especially in the earlier decades of life murmurs of 'organic' nature resulting from actual valvular disease are very uncommon

PULMONIC STENOSIS The mechanics of the production of the murmur here is the same as that described under aortic stenosis Congenital stenosis or other valvular anomaly is the most frequent cause, less commonly rheumatic disease and vegetations of bacterial endocarditis and disseminated lupus erythematosis may affect the cusps

The murmur is systolic in time and is heard best at the pulmonic area radiating to the left upper front of the chest and to the left portion of the back (Fig 20) Its characteristics in general are similar to those of the murmur of aortic stenosis A thrill accompanies the murmur of pulmonic stenosis (This murmur may be differentiated from a physiologic murmur by reference to the preceding chapter)

* The Bowles or diaphragm type of stethoscope will amplify the faint aortic diastolic murmurs

The murmur of relative mitral insufficiency is systolic in time, since blood regurgitates through the incompetent valve at the time of ventricular contraction As in mitral insufficiency due to rheumatic fever this murmur is heard at the apex with possible radiation to the

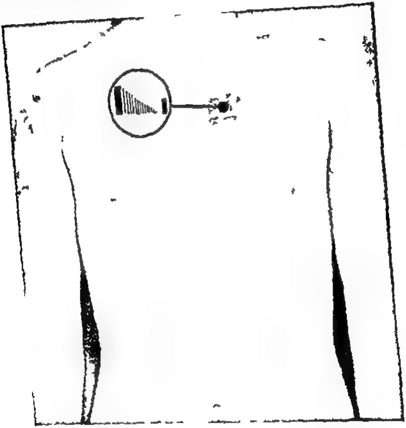


Fig 0 Murmur of pulmonic stenosis is localized with little radiation to left second interspace Systolic decrescendo character is diagrammed within circle

axilla and over the precordium It is usually high pitched and has a blowing quality The intensity varies greatly depending to some extent upon the state of the myocardium and thus the force of ventricular contraction With weak heart sounds as in the failing heart the murmur may be merely a faint systolic puff On the

countered most frequently in the most common cause of death in this country, namely, in hypertensive and arteriosclerotic heart disease. Left ventricular dilatation also occurs as the result of aortic valvular disease—stenosis or insufficiency. Acute myocarditis as from

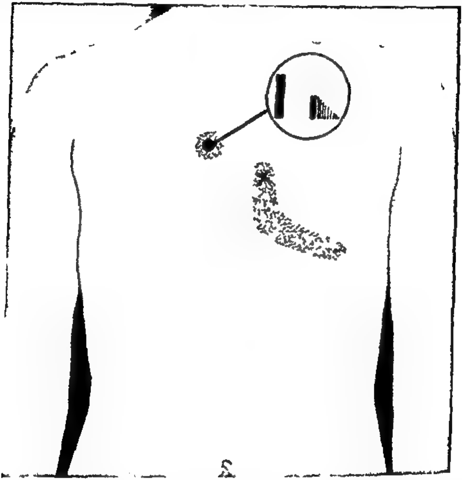


Fig 19 Localization of murmur of aortic insufficiency to right second interspace is shown by solid and stippled areas. It may be heard and intensified at *Erb's point (X) in third left interspace*. Its radiation downward along sternal border toward apex and axilla is shown. Decrescendo character of early diastolic murmur is diagrammed inside circle.

rheumatic fever and diphtheria and as the result of prolonged infection and fever, such as typhoid fever, commonly results in dilatation of the heart. In anemia with its accompanying decreased oxygenation myocardial changes may lead to dilatation and relative mitral insufficiency. The murmur also may be encountered in thyrotoxicosis.

cause of an aortic systolic murmur Such pathologic changes may represent calcified atherosclerotic plaques, which project somewhat into the lumen of the aorta

The murmur of relative aortic stenosis will have the characteristics generally associated with the murmur of true aortic valvular disease However the murmur is less likely to be so harsh and rarely will there be the anticipated thrill so common in aortic valvular stenosis

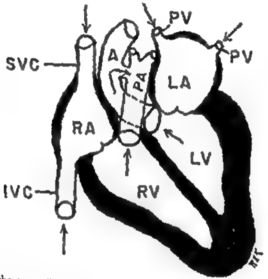


Fig 21 Schema illustration of flow of blood (arrow) from aorta into pulmonary artery via patent ductus arteriosus in systole (it continues into diastole because of a high intra aortic pressure)

RELATIVE AORTIC INSUFFICIENCY *This is met with uncommonly* Occasionally long sustained hypertension with a high diastolic level may cause sufficient dilatation of the aortic ring so as to interfere with complete closure of the intact cusps Thereby a regurgitant flow of blood is permitted in diastole Likewise relaxation of the aortic ring with resultant incompetency of the valves may be encountered very rarely in myocarditis inflammatory or degenerative as may occur in acute infections or in anemia

The murmur of relative aortic insufficiency will have in general the same characteristics as those described for the early diastolic murmur of valvular deformity However, the murmur is almost cer

other hand, in the slowly contracting ventricle as encountered in the presence of aortic stenosis, the murmur of relative mitral insufficiency may be loud and forceful The murmur of relative mitral insufficiency is not altered by position, exercise, nor posture to the degree which occurs in the functional murmurs, described in the preceding chapter

RELATIVE MITRAL STENOSIS (AUSTIN FLINT MURMUR) In wide open aortic insufficiency a fair sized stream of blood regurgitates backward into the ventricle during diastole, impinging upon the anterior mitral leaflet at the same time that blood is flowing under less pressure from the atrium Probably the aortic regurgitant stream produces a relative stenosis since it strikes and no doubt displaces the anterior leaflet to a partially closed position, thereby producing the characteristic murmur Some students of the problem point out that the meeting of the two streams of blood and the probable vibration of the valve leaflet caught between these streams may be further factors in the production of this murmur (Fig 18)

The Austin Flint murmur simulates the murmur of true mitral stenosis in its late diastolic low pitched, rumbling characteristics It may have a crescendo character, though less often than the murmur of actual mitral valvular disease nor does the first sound show the typical change Furthermore, the effect of position is not so clear cut in the Austin Flint murmur as in true mitral stenosis, since it is commonly heard as well with the patient in the sitting position as in the recumbent

Tricuspid Murmurs *Relative tricuspid insufficiency* may occur because of dilatation of the right ventricle with the same dynamics as described for relative mitral insufficiency In effect such a murmur will be no different from that of tricuspid valvular deformity *Relative tricuspid stenosis* does not occur

Aortic Murmurs RELATIVE AORTIC STENOSIS A murmur suggesting a stenotic aortic valve may occur in the absence of such a lesion In the event of an "aneurysmal" dilatation of the supravalvular portion of the aorta, as may occur in syphilis the aortic ring is relatively narrowed in comparison to the dilated aorta Thus a murmur will be set up by the eddies produced as blood flows under pressure from a narrow to a wider area An area or areas of roughness in the intima of the aorta immediately beyond the valve ring may be the

increase in the diameter of the valvular ring. Thus the cusps cannot close the orifice completely, permitting a regurgitant flow of blood in diastole. The best examples of relative pulmonary insufficiency are found in instances of high grade mitral stenosis which causes great back pressure upon the lesser circulation.

The Graham Steell murmur is heard at the pulmonic area early in diastole. It has a decrescendo blowing quality and is usually soft and transmitted downward along the left border of the sternum. It must be differentiated from the murmur of aortic insufficiency.

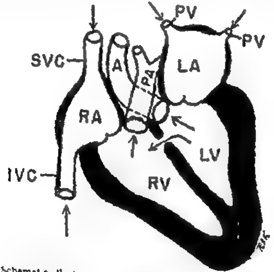


Fig. 23. Schematic illustration to show flow of blood (arrow) from higher pressure left ventricle through interventricular septal defect during systole.

Murmurs of Hemic Origin. Murmurs of various types will be noted occasionally by every physician in the presence of high degrees of anemia. The most common are those at the apex. They are systolic in time and are thought to represent relative mitral insufficiency due to ventricular dilatation because of an overworked cardiac muscle with an inadequate oxygen supply. However, murmurs may be heard at other valve areas. The murmur of aortic insufficiency may be encountered as well as a systolic murmur at the aortic area. It is possible that blood of lowered viscosity passing through valve orifices may be much more prone to set up turbulence and thereby vibrations

tain to be less prolonged and less intense, often being very faint It is also frequently inconstant, being present upon one occasion and absent at another, it is often heard only in the upright position, the patient leaning forward and holding his breath in expiration

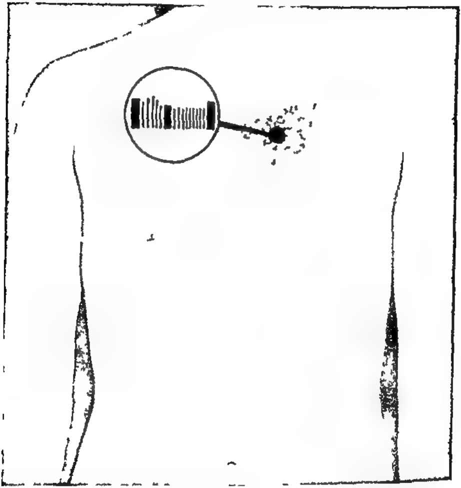


Fig 22 Localization of murmur of patent ductus is in second left interspace (continuity of murmur throughout systole and diastole with its greater intensity during systole is shown within circle)

Pulmonic Murmurs Relative pulmonary stenosis does not occur The systolic murmur of physiologic origin at the pulmonary area was discussed in the preceding chapter

RELATIVE PULMONARY INSUFFICIENCY (GRAHAM STEELL MURMUR) Because of a high pressure in the pulmonary circulation some dilatation of the pulmonary artery may occur, with a resultant

cardiac cycle (Fig 21) At times this is loudest during the systolic phase The murmur is often described as machinerylike Though the murmur is likely to be most intense in the second interspace at the left border of the sternum, it often radiates widely in all directions

Fig 25 Angiocardiogram showing coarctation of aorta *Site of obstruction and some of the collateral circulation are obvious*

(Fig 22) A thrill which is continuous is the palpable equivalent of the murmur though it may be more, or only noticeable in systole the period of the greatest intensity of the murmur

Patent Interventricular Septum In the presence of such an anomaly blood flows from a high pressure level in the left ventricle to a lower pressure level in the right ventricle (Fig 23) A systolic murmur (Rogers murmur) is produced or heard at its maximum

than blood under normal circumstances These murmurs disappear with improvement of the anemia

Murmurs Due to Congenital Anomalies of the Heart There are a number of congenital anomalies in which murmurs occur, and these abnormalities may occur singly or in combination *Aortic and*

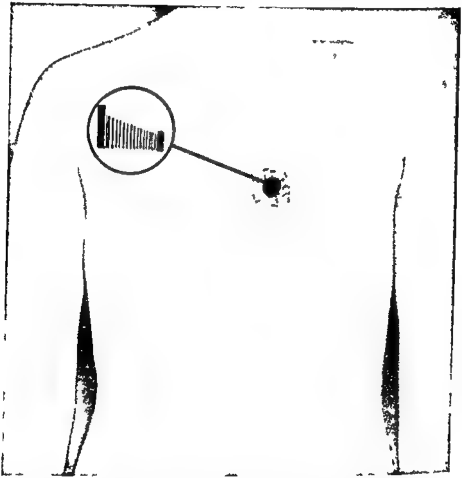


Fig 24 Murmur of interventricular septal defect is localized to fourth left interspace Duration throughout systole is diagrammed within circle

pulmonic valve anomalies—two cusps instead of three—have already been mentioned under Aortic Stenosis and Pulmonic Stenosis

Patent Ductus Arteriosus Blood passing from the higher pressure area of the aorta through an open ductus to the lower pressure level of the pulmonary artery will be accompanied by continuous vibrations or a continuous murmur (Gibson's murmur) throughout the

murmur is heard over wide areas again it is quite sharply localized A murmur posteriorly must be differentiated from the bruit of the dilated arteries of the collateral circulation The systolic murmur is felt as a thrill

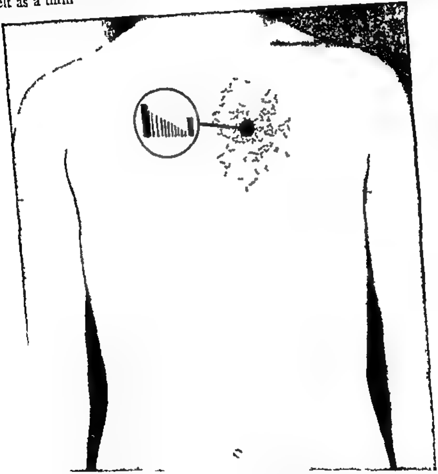


Fig 27 Murmur of aortic coarctation is most intense at second left inter space with wide radiation Continuity throughout systole is diagrammed within circle

PERICARDIAL FRICTION SOUND

As was indicated earlier in the chapter in the presence of a fibrin deposit on one or both surfaces of the pericardium vibrations will be produced by movement of the roughened surfaces one against

intensity in about the fourth intercostal space at the left of the sternum (Fig 24) (A thrill accompanies the murmur)

Patent Interauricular Septum If the opening is of moderate or greater size, blood flows from the left to the right atrium during

Fig 26 Collateral circulation in intercostal arteries

diastole There may be no murmur or because of the dilated pulmonary artery, a systolic murmur and thrill may be present at the pulmonic area A diastolic murmur is occasionally heard

Coarctation of the Aorta This represents a constriction of the aorta at a point between the origin of the left subclavian artery and the site of the ductus arteriosus (Figs 25 26) A harsh murmur systolic in time, is heard at the aortic and pulmonic areas and also in the back in the left scapular area (Figs 27 28) At times, the

flammatory or malignant process in the lung eroding into the pericardial sac The contractions of the heart in a medium of fluid and air will set up a sound which may be described as of a churning or splashing character The sounds have a metallic ring as was described for hydropneumothorax Pneumopericardium is encountered as an extreme rarity in any one physician s experience

ARRHYTHMIAS

Though deviations from normal sinus rhythm may be recognized upon inspection and palpation of the apex beat and of the arteries auscultation provides the best method of their analysis The electrocardiogram is the last court of resort in the diagnosis of certain arrhythmias or in the differentiation between arrhythmias at times

Fig 9 Paroxysmal auricular tachycardia (rate 212 per minute)

However since this is a text neither for medical diagnosis nor on electrocardiography electrocardiograms are used merely to illustrate the fundamentals of the several arrhythmias

Sinus Tachycardia A heart rate of from 100 to 130 or 140 having its pace set by the sino auricular node represents *sinus tachycardia* In the preceding chapter it was *pointed out that tachycardia* of this type occurs in the absence of disease merely as the result of exercise and emotion (Fig 18 page 429)

In disease the same mechanism operates as the result of pain blood loss fever excitement anoxia and in thyrotoxicosis to mention common causes only

the other This friction rub is audible, as well as at times palpable, as a to and fro friction sound, synchronous with the systolic and diastolic movements of the heart

The sounds are rough, scratchy, or grating, and sound as if they were close to the ear The friction sound may be heard over much of the precordium in pericarditis of infectious or uremic origin, because of widespread fibrin deposit in the former and the scattered areas of

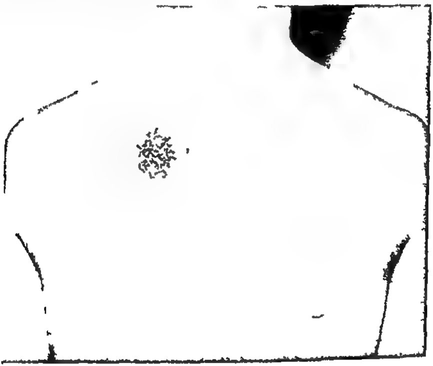


Fig 28 Radiation of murmur of coarctation of aorta to left interscapular area

fibrin in the latter At times as over a myocardial infarct, the friction rub may be sharply localized at the left of the sternum in the region of the third or fourth interspace

HYDROPNEUMOPERICARDIUM

Air in the pericardial sac is always accompanied by fluid Hemopneumopericardium may result from stab or gunshot wounds Hydropneumopericardium or pyopneumopericardium results from an in

arying intensity of the first sound It can be accurately differentiated only by the electrocardiogram

Auricular Flutter In this disturbance of rhythm there is an absolutely regular auricular rhythm with a rate of from 240 to 360 or

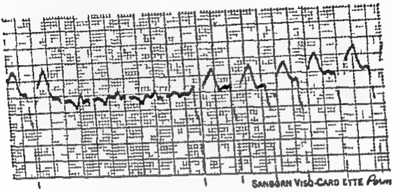
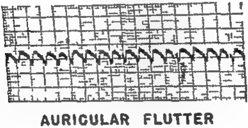


Fig 30 Several beats in sinus rhythm are preceded and followed by ventricular tachycardia



Fi 31 Auricular flutter (4 1) Auricular rate 300 ventricular rate 75 per minute

so per minute (Fig 31) This is supposed to be due to circus movement of the wave of excitation continuously around the atrium * Though usually indicative of severe myocardial damage being found

* Recently Prinzmetal and his collaborators have questioned the circus movement theory By use of slow moving pictures they have found that flutter waves travel in *all* d rections from an ectopic focus and not in one circular direction They feel that flutter contractions are similar to those of paroxysmal tachycardia The discharge from the focus is more rapid than in paroxysmal tachycardia though slower than in fibrillation Circulation 7 607 1953

Sinus tachycardia is characterized by a gradual increase and decrease in the rate Its origin in the sino auricular node may be proved by a slowing of the rate on deep inspiration and by vagal pressure

Sinus Bradycardia An increase in vagal tone occurs in the presence of jaundice, in convalescence from prolonged illness, especially of the febrile infectious disease and as the result of elevated intracranial pressure (Fig 18, page 429)

That the bradycardia is of sino auricular origin is shown by still greater slowing through pressure upon the vagus nerve or by an increase of the heart rate upon exercise or upon deep inspiration

Auricular Paroxysmal Tachycardia This arrhythmia is thought to be due to an area of irritable auricular muscle which acts as a source of rapid, regular impulses (Fig 29) It usually occurs in persons who are well, certainly not suffering from heart disease since recurrent attacks appear for decades, each lasting for minutes or hours On the other hand this arrhythmia may appear at times in the presence of heart disease

The rhythm in this abnormality is perfectly regular, with a *fixed* rate at from 150 to 180 per minute or more An attack begins and ends abruptly changing for example, from a rate of 160 per minute to a rate of 80 in one cardiac cycle At times several premature contractions occur just before the onset and immediately after the offset of the attack Exercise produces no effect upon the rate indicating that the tachycardia is not of sino auricular origin Vagus stimulation by one of several methods may end the attack abruptly

Nodal Paroxysmal Tachycardia If the tachycardia has its origin in the auriculoventricular node it can not be differentiated clinically from auricular paroxysmal tachycardia The differentiation is based upon the pattern of the P waves in the electrocardiogram Whenever differentiation is impossible between auricular and nodal paroxysmal tachycardia the term supraventricular tachycardia is commonly applied today

Ventricular Paroxysmal Tachycardia This is due to an irritable focus in the ventricular muscle (Fig 30) and usually is indicative of serious myocardial disease It does not respond to vagal stimulation as does the auricular type The experienced clinician may at times suspect this arrhythmia on the basis of slight variations in rate and

regards time but they also vary in strength Some are too weak to be felt as a pulsation in the peripheral arteries Thus the observer may by auscultation count a rate of 140 beats per minute at the cardiac apex and at the wrist feel only 115 a *pulse deficit* of 25 beats The deficit in beats represents those ventricular contractions which are too weak to transmit the pulse wave peripherally Blood pressure deter mination in such cases is quite inaccurate since some beats may be

Fig 32 Auricular fibrillation QRS complexes (ventricular contractions) are spaced irregularly

heard let us say at 180 mm of mercury twice as many at 150 mm and all at 120 mm of mercury Which is the true level of blood pressure?

The diagnosis of auricular fibrillation usually is established by the presence of the characteristics just noted Fibrillation is usually not difficult to differentiate from premature contractions Exercise com monly accentuates the arrhythmia of ventricular contractions in auricular fibrillation and decreases it in premature contractions

Premature Contractions (also known as "extrasystoles" or "ectopic beats" which are misnomers) Such contractions may arise in the auricle the atrioventricular node or in the ventricle This disturbance represents the most common arrhythmia the student and physician will encounter exclusive of sinus arrhythmia Premature contractions do not by themselves signify cardiac disease or at least certainly not disease of an irreversible type They often occur in febrile diseases or during convalescence from such in various infec tions and from the use of nicotine They are common in established heart disease Ventricular premature contractions probably are more indicative of myocardial disease

in the heart disease of arteriosclerosis, hypertension, mitral stenosis and thyrotoxicosis, flutter is encountered on occasion in normal hearts

Since the auriculoventricular node cannot respond to each impulse a 2 1, 3 1, or 4 1 block develops This means that the auriculoventricular node and ventricle respond to only one of two, three or four auricular impulses Thus the electrocardiogram may show an auricular rate of 240 and a ventricular one of 120

The diagnosis of this fortunately uncommon disturbance is often impossible without the electrocardiogram Though vagal stimulation may temporarily slow the rate in auricular flutter, an abrupt termination is not brought about as in auricular paroxysmal tachycardia The slowing represents merely an increase in the auriculoventricular block and not a change in the fundamental rhythm

By careful auscultation the examiner may in some cases hear additional sounds in diastole representing auricular contractions If one recalls that most auricular flutter rates are in the range of 200 to 360 and that a 1 1 rhythm is rare it is obvious that ventricular rates around 200 can not be due to flutter In occasional cases the pattern of the block varies from time to time A change from a 2 1 to a 3 1 or 4 1 block or the reverse may give the clue to the form of the arrhythmia at hand

Auricular Fibrillation Next to *premature contractions* to be considered below, this arrhythmia is the most frequent in the physician s experience Fibrillation is thought to be the result of many irritable foci in the atrial wall, the excitation wave passing through the atrial musculature more rapidly and irregularly than in flutter The auriculoventricular node is bombarded by numerous impulses at a variable rhythm and of variable force Depending upon the degree of the refractory state of the ventricular muscle ventricular contractions may be set off Auricular fibrillation practically always indicates serious myocardial disease of hypertensive arteriosclerotic, mitral stenotic, or thyrotoxic origin Occasionally, it is encountered in paroxysmal attacks in apparently healthy persons

Auricular fibrillation is characterized by an absolute irregularity of ventricular rhythm for reasons noted in the preceding paragraph (Fig 32) The more rapid the ventricular rate the more apparent is the arrhythmia Not only are the ventricular beats irregular as

the aortic valve or contracting on a small amount of blood in the ventricle result in a *pulse deficit* and thus may simulate auricular fibrillation At times a premature contraction may be so weak that it suggests the drop beat of heart block to be considered below Again every other beat is a premature one giving rise to coupling or bigeminy if every third beat is premature the term *trigeminy* is used (Fig 34)

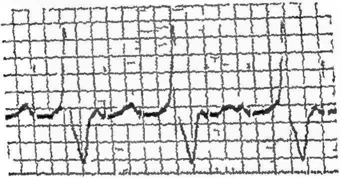


Fig 34 *Trigeminy* Ventricular premature contractions appear after second normal beat

Auriculoventricular Block (Heart Block) Here one is dealing with impairment of the conduction of the impulse from the auricle to the ventricle

Heart block is classified as first second and third degree block The disturbance is located either in the auriculoventricular node or in the bundle of His It is indicative of definite myocardial disease in the absence of the use of certain drugs It is most commonly caused by rheumatic disease of the heart muscle and by myocardial infarction It may occur in myocarditis of any type such as of diphtheria for example Rarely it occurs in syphilis and as a congenital anomaly

First-degree block results from a delay in atrioventricular conduction and cannot be recognized clinically It is indicated by a prolonged P R interval in the electrocardiogram An audible auricular contraction before the first sound may suggest the condition A decreased intensity of the first sound may lead the astute clinician to suspect first degree block

A premature contraction results from the appearance of a stimulus earlier than expected This stimulus may originate in the sino auricular node, in an ectopic focus in the auricle or ventricle or in the auriculo-ventricular node Following the premature contraction there is a *compensatory pause* until the next impulse from the sinus node stimulates a ventricular contraction If the premature contraction is of auricular origin the impulse from the ectopic focus reaches the

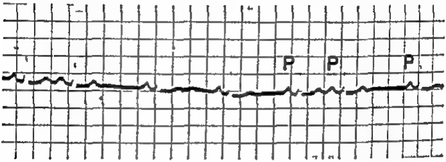


Fig 33 Auricular premature contractions (P waves are of auricular origin) Second P wave which is notched is premature contraction Premature cycle plus following one do not quite equal two normal cycles

sinus node and temporarily disrupts its rhythmicity so that the discharge of the next regular impulse is usually longer than the average time This results in a longer pause after the premature contraction but the total time between the two regular beats is usually a little less than between two normal beats If the premature contraction is of ventricular origin the ectopic impulse will not reach the sinus node in time to disrupt its rhythm Hence, the interval between the normal beat and the premature contraction plus the waiting period or compensatory pause which follows will exactly equal the time interval between two normal beats

The electrocardiogram can determine the origin of the premature contraction (Fig 33) Upon auscultation the observer recognizes the premature contraction by a beat appearing sooner than expected, to be followed by a compensatory pause The novice and even experienced clinician may have difficulties in diagnosis at times, however "Runs" of premature contractions with no normal beats may suggest paroxysmal tachycardia Numerous scattered premature beats, some too weak to force the pulse wave to the periphery, or even to open

auriculoventricular valves snapping back with ventricular systole When such accentuation occurs at intervals the diagnosis of complete block is established This item in the physical examination may be essential in the differentiation of complete block from sinus bradycardia a question which may arise in instances of rates of from 50 to 60 per minute

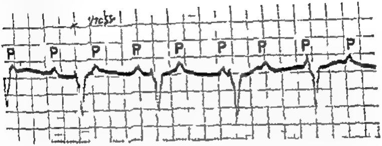


Fig 36 Complete auriculoventricular block Ventricular rate is about 60 auricular about 107 per minute QRS complex at extreme right has superimposed auricular contraction which may accentuate first sound at apex

THE PULSE

Before considering the changes from the normal in the pulse as found in disease it is worth mentioning certain visual observations which are helpful A common manifestation of arteriosclerosis is the pulsating brachial artery taking a serpentine course on the inner aspect of the upper arm The same change may be noted in the temporal artery in the common and/or external carotid artery in the radial artery and in others (Sites of abnormal pulsation are significant for example the pulsation of dilated *intercostal* arteries may represent collateral circulation as the result of coarctation of the aorta)

Palpation of the artery may reveal this *tortuosity* In evaluating the *thickness* of the arterial wall as described in the foregoing chapter it was noted that the vessel wall may be palpable in middle or later life when the blood flow has been obstructed above the point of palpation Palpability of the empty artery represents some arteriosclerosis or thickening of the arterial wall In old persons this is always present Actually the thickening may be of such degree or hardness that it may be almost impossible to flatten the artery sufficiently to obstruct the blood flow Such a hard artery probably with calcification of

Partial auriculoventricular block (second degree) is readily recognized through the so called 'drop beat,' a ventricular contraction being completely missing at regular intervals (Fig 35) This permits such descriptive terms as 2 1 or 3 1 This means that only every second or third *impulse reaches the ventricles* (*The ventricular rate is consequently one half or one third that of the auricle*) Another

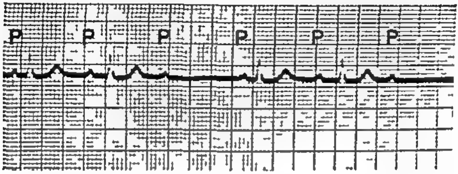


Fig 35 Partial auriculoventricular (second-degree) block (P waves are of auricular origin) Note absence of QRS complex dropped beat in center (Wenckebach phenomenon is shown—increasing P R interval because of prolonged conduction for two beats followed by dropped beat)

type of partial block is that in which each conduction cycle shows successive lengthening of the P R interval until an auricular impulse fails to reach the ventricle This is known as "Wenckebach s phenomenon "

Complete auriculoventricular block (third degree) represents complete dissociation of the auricle from the ventricle, the latter setting up its own rhythm in the auriculoventricular node or bundle (idioventricular rhythm) at a rate commonly of 32 to 45 beats per minute At times, the rate is higher, from 50 to 60 per minute (Fig 36) The physiologic cutting of the bundle of His is encountered most commonly in myocardial infarction, very rarely in syphilitic gumma of the interventricular septum Upon auscultation the condition is usually obvious because of the slow rate, influenced only slightly by exercise or by any other maneuver The faint auricular contractions may be heard in some cases during the long ventricular diastole At intervals the intensity of the first sound is accentuated the *bruit de canon* This occurs whenever the auricular contraction precedes the ventricular one at a short optimal interval the low lying and relaxed

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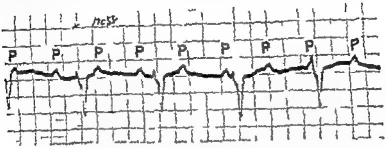

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of the pulse wave In the presence of an arteriovenous fistula, either in the acquired type or in the congenital type (patent ductus arteriosus), the water hammer pulse is characteristic, again because of a poorly sustained diastolic blood pressure level

The term *thready pulse* is commonly applied to describe the pulse wave of shock, or as found at times in heart failure This is a pulse of a quick but small or weak wave, somewhat like the bounding pulse *in miniature*, giving an impression of a weak pulse

In aortic stenosis, blood being ejected slowly from the ventricle through a narrowed valve orifice, the pulse wave rises slowly, is sustained longer than under normal circumstances, and then falls slowly This type of wave has provided through long usage the descriptive term the *plateau pulse*

In the sphygmographic tracing obtained in the normal subject, as the student has learned in the physiology laboratory there is a notch on the descending portion of the pulse wave with a secondary rise called the *dicrotic wave* The notch is deepened during fevers but usually tachycardia prevents the average physician from feeling it in the wave In typhoid fever however and under other less common circumstances the tachycardia may be lacking Then the secondary wave may actually be palpated, such a wave provides the term *dicrotic pulse* (At the beginning of the century much was made of this in the clinical diagnosis of typhoid fever)

The *paradoxical pulse* is manifested as a waxing of the pulse wave in expiration and a waning on inspiration * This is of significance as a sign of cardiac tamponade in pericardial effusion and in constrictive pericarditis In other conditions with changing intrathoracic pressure as in asthma for example a paradoxical pulse may be encountered occasionally

Capillary Pulse The demonstration of a very clear cut capillary pulse is almost certain evidence of the high pulse pressure of free aortic insufficiency of which it is considered to be diagnostic

Auscultation of Arteries In the presence of free aortic insufficiency, if a large (femoral) artery is partially compressed and a stethoscope bell applied proximal to this point a diastolic murmur

* With an increase in negative pleural pressure on inspiration there may occur stasis in the great veins and auricles thereby reducing the blood volume of cardiac output

will result This *Duroziez murmur* is an expression of the ill sustained diastolic pressure permitting reversal of the blood flow (With a high pulse pressure as the stethoscope bell is pressed upon a large artery a loud sound occurs in systole—the *pistol shot* sound of Traube) In the neighborhood of the site of an arteriovenous fistula a con tinuous bruit is audible transmitted both distally and proximally along the course of the vein involved in the process The murmur may be louder in systole than in diastole

Blood Pressure

The blood pressure may be altered in disease in either or in both the systolic and diastolic pressures and in the upward or downward directions Thus there may be systolic and/or diastolic hypertension or hypotension

Best and Taylor* point out that arterial tension depends upon five factors

1 The pumping action of the heart
2 The peripheral resistance
3 The quantity of blood in the arterial system
4 The viscosity of the blood
5 The elasticity of the arterial walls

Hypertension A large number of factors singly or in combina tion interpreted in light of those listed above may cause an elevation of the blood pressure Hypertension means an elevation of the pres sure to a level above the normal As was described in the foregoing chapter the upper limits of normal are accepted as 140 mm of mercury or slightly more for the systolic pressure and about 100 mm for the diastolic Obviously hypertension is slight if it is at the level of 150 mm of systolic and 110 mm of diastolic moderate if from 180 to 190 mm of systolic and from 115 to 120 mm of dias tolic and high if from 200 to 250 mm or more of systolic and from 130 to 160 mm of diastolic pressures It is not implied that both systolic and diastolic pressures are always elevated proportionately They may or may not rise together This will appear below

* Best C H and Taylor N B The Physiological Basis of Medical Practice. The William & Wilkins Co Baltimore 1945 page 121

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'Essential hypertension represents an elevation of blood pressure ᵢithout any clear cut cause, though it is recognized as being related ᵢ the arteriolar bed, in terms of vasoconstriction or resistance to the lood flow (This may be proved by giving such a patient a heavy ose of a barbiturate sedative During the sleep induced, the blood ressure will drop and be maintained at a level often from 50 to 80 ım below that of the waking level) The most common hypertension ncountered in practice is of this type, appearing in middle age and ınning a *benign* course over many years Such blood pressures are ommonly maintained at levels of from 180 to 220 mm of systolic nd from 100 to 125 mm of diastolic pressure (Arteriolar sclerosis lso may be a factor in such cases though one cannot be sure whether s presence is cause or effect) A more fulminant type of hypertension the *malignant* which is likely to occur at an earlier age and run s course to death in months or at most in a few years This type ften shows blood pressure levels of from 230 to 260 mm of systolic ıd from 130 to 160 mm of diastolic pressure

Heart disease may be the cause of hypertension Thus in *free* aortic ısufficiency the systolic pressure is often elevated in an attempt on e part of the heart to provide an adequate blood flow (This is ifficult because the intra aortic diastolic pressure cannot be main ıned, the diastolic pressure is low because of the valvular incom etency) The pressure levels may be of the order of a systolic ressure of from 175 to 200 mm of mercury and a diastolic pressure from 40 to 50 mm These circumstances also obtain in instances arteriovenous fistula

The hypertension of aortic insufficiency is accompanied by a greater evation in the lower extremities (even up to 80 mm) This so ılled 'Hill phenomenon' is probably due to a greater blood velocity the lower extremities because of gravity and the vessels of the ıwer extremity taking a course which is a direct extension of the ɔrta

Endocrine imbalance may be a causative factor in hypertension This may be actually mediated through the sympathetic nervous stem with vasoconstriction of the vascular bed) The most frequent ample is the systolic elevation of pressure in thyrotoxicosis Due to e increased blood flow in the presence of higher metabolic needs,

the systolic pressure rises, with little elevation in the diastolic level resulting in a higher pulse pressure Levels of say 180 mm of systolic with 95 or 100 mm of diastolic pressure are common Basophilic adenoma of the pituitary gland is characteristically accompanied by hypertension A paroxysmal type of hypertension with sudden high levels appearing in a person usually having normal levels is suggestive of adrenal gland tumor

Chronic glomerular nephritis polycystic kidney disease and other renal abnormalities decreasing the vascular bed in these essential organs produce a diastolic hypertension Thus levels of 220 mm of systolic and from 130 to 140 mm of diastolic pressure are common

Obesity is commonly associated with moderate levels of hypertension possibly representing an increased blood volume The increased viscosity of the blood in *polycythemia vera* is thought to account for hypertension in these cases a greater resistance to cardiac systole being evident

A *miscellaneous* set of circumstances may account for hypertension occasionally In this group we find the hypertension of toxemia of pregnancy increased intracranial pressure (an effect on the central vascular regulating mechanism) coarctation of the aorta presenting increased peripheral resistance in the collateral arterial circulation

Hypotension In the preceding chapter it was indicated that normal asthenic persons not unusually have systolic pressures as low as 90 mm of mercury and diastolic pressures of 50 mm Anything below this should be considered abnormal (Actually of course in a patient formerly having hypertension a drop may occur from high levels to more nearly normal levels as in heart failure or with and after myocardial infarction for instance This represents a relative hypotension)

In *shock* associated with the vasodilatation of the peripheral vascular bed hypotension is characteristic *Vagotonia* is characterized by hypotension because of the decreased vasomotor tone

Cardiac failure is an inability of the myocardium to maintain the usual level of its function As dilatation occurs following hypertrophy or as the result of myocardial infarction or with diffuse toxic or infectious myocarditis a drop in blood pressure from former levels is to be expected

Endocrine disease as a cause of hypotension is seen both in myxedema (usually) and in hypoadrenalism (Addison's disease) always

Decreased blood volume seen at its best in massive hemorrhage is characterized by a drop in blood pressure levels The decreased viscosity of the blood in severe anemia also is reflected as hypotension

Miscellaneous causes of hypotension are, in general, related to poor vasomotor tone Thus in prolonged *debilitating* illness, as in carcinoma or tuberculosis, hypotension is common In the *convalescent period* following prolonged febrile disease as after typhoid fever and malaria the pressure is commonly low A *hypersensitive carotid sinus reflex* may be a cause of a drop in pressure In persons presenting *postural hypotension* there is a lag in prompt vasoconstriction of the peripheral vascular bed upon assuming the upright position It may be present in those having tabes dorsalis (Many persons experience this to a mild degree upon suddenly assuming the upright position as in springing out of bed just after a sound sleep Vasoconstriction, upon taking the erect position, may lag momentarily with resultant dizziness) Lowered blood pressure levels are met with in rapidly accumulating *pericardial effusions*

Inequality of Pressure in the Arms This may be of great significance, though all too commonly it remains unexplained A difference of 15 mm or more between the pressures in the two arms should arouse the observer's attention

The unexplained cases of marked discrepancy are probably related to arterial anomalies Thus we have had in the clinic several patients known to have 30 to 40 mm differences in systolic pressure between the two arms for two decades without any apparent reason More commonly mediastinal tumors solid or aneurysmal are the cause of discrepancies in pressure by a partial blocking of certain large arteries Inequalities in some instances may be due to atheromatous changes at the orifices of the large vessels

Pressure in the Lower Extremities Reversal of the usual differences—that is lower pressure in the lower extremities—is seen in coarctation of the aorta and in obstruction of the abdominal aorta or iliac arteries by extrinsic pressure On the other hand the popliteal pressure may be definitely higher than the brachial pressure in thyrotoxicosis, arteriosclerosis and aortic regurgitation

Arrhythmias These have been discussed under the heading of Arrhythmia in the section on auscultation of the heart and in the section on the pulse In the auscultatory determination of blood pressure in addition to pulsus alternans the arrhythmias of auricular fibrillation premature contractions and partial heart block, are obvious

Clinical Picture of Heart Disease

As has been pointed out before this book is not a textbook of medical diagnosis However, just as I have done in the case of pulmonary disease I wish to present briefly the physical findings in the several types of heart disease My objective merely is to apply the numerous isolated abnormalities which have been described above in an integrated fashion for a rounded out picture of heart disease of any one kind This is done briefly so that the second year student in this introduction to clinical medicine may have some concept of how physical signs are applied in the case study and diagnosis

CARDIAC FAILURE

Before describing the physical signs in the various types of heart disease it may be well to consider the signs of heart failure This will be helpful I believe in that the student may appreciate that failure of one type or another is the ultimate outcome in most of the types of heart disease to be considered below Failure is the eventual result in most instances of heart disease if intercurrent disease does not cause death before failure supervenes (This text is not the place to discuss the pathologic physiology in detail The student is referred to text books on physiology clinical medicine or to the numerous excellent texts on heart disease)

The term *coronary insufficiency* is commonly applied when the principal feature is that of coronary artery disease manifest either as anginal pain or as coronary occlusion

Congestive failure is the state of myocardial insufficiency wherein the heart muscle is unable to carry out its function under normal or ordinary demands

Left Heart (Ventricular) Failure In the event of long continued strain upon the left ventricle the time will arrive when it can

no longer perform its normal function Then *breathlessness* upon exertion becomes noticeable, to be followed soon by *orthopnea* which means dyspnea in the recumbent position *Paroxysmal nocturnal dyspnea* ('cardiac asthma') is almost diagnostic, a circumstance in which the patient awakens after several hours of sleep, intensely dyspneic and with a sense of suffocation due to pulmonary congestion or edema It results from the more nearly normal right heart passing blood to the pulmonary circulation and thus to the left heart more rapidly than the latter is prepared to handle it

Signs Patients with left ventricular failure commonly have (1) a decrease in vital capacity and (2) an accentuation of the pulmonary second sound because of the increased pressure within the lesser circulation (3) Crepitant rales at the lung bases also represent evidence of congestion of the pulmonary vascular bed In failure of the left ventricle a protodiastolic gallop rhythm (4) is common, in a more serious or later stage of failure an alternating pulse (5) appears

Right Heart (Ventricular) Failure When the time arrives in which the right heart cannot accommodate the blood brought to it from the venous system congestive right heart failure is established It will be manifested essentially in terms of increased venous pressure and its accompaniments (More recently the theory of backward failure is being questioned)

Signs (1) Venous distention is usual noted in the neck veins in the upright position since, because of back pressure they are unable to empty by gravity as in the normal person The increased venous hypertension plus certain other factors leads to (2) edema of dependent portions of the body (3) Congestive enlargement of the liver is noted accompanied by tenderness (4) The accumulation of a transudate in the serous lined cavities pleural and peritoneal eventually occurs

Left and Right Heart Failure Commonly both forms of congestive failure are present Thus for example left ventricular failure may be established for a time Finally because of the left ventricle's inability to accommodate all the blood passed to it by the right heart back pressure increases and then the right heart fails in its function The full brunt of inadequate cardiac function then falls upon the

systemic venous circulation to show itself in the signs of right heart failure

With the realization that heart failure is the final state in most instances of cardiac disease the various types of heart disease may now be considered These entities are presented essentially in the order of their frequency in the physician s practice

ARTERIOSCLEROTIC HEART DISEASE

Definition Impairment of cardiac function due to ischemia of the heart muscle because of vascular disease a development in middle age and beyond ending in coronary insufficiency or congestive heart failure

Pathology Evidences of myocardial degeneration due to age and ischemia arteriosclerosis of the coronary arteries with, at times areas of myocardial infarction recent or healed, uncommonly and rarely calcific changes in the aortic valve and the interventricular septum respectively

Physical Signs *Inspection* PMI if visible in the fifth or sixth interspace between the midclavicular and anterior axillary lines depending upon the degree of hypertrophy and/or dilatation *Palpation* PMI if palpable at the site as above, its force dependent upon the functional state of the myocardium *Percussion* Left border of cardiac dulness displaced toward the anterior axillary line unless unpercussible because of pulmonary emphysema *Auscultation* Heart sounds of good quality weak and muffled (possibly a gallop rhythm) if in failure distant or inaudible in the presence of marked emphysema of the lungs a blowing systolic murmur heard best at the apex radiating over the precordium and to the left in the presence of enlargement and/or dilatation at times at the aortic area a harsh systolic murmur radiating upward and rarely a short blowing early diastolic murmur radiating downward at the left border of the sternum if calcific valvular disease is present *Pulse* Thickened radial arteries pulse wave not remarkable *Blood Pressure* Normal or a systolic hypertension

Remarks Congestive failure if present is of the left ventricular type at first later may be followed by right heart failure In the mild cases this may be a long drawn out course Auricular fibrillation is

common Rarely calcification or infarction in the interventricular septum causes complete heart block with the establishment of idio ventricular rhythm * Severe myocardial infarction is accompanied by an absent or weak PMI, tachycardia, heart sounds of poor quality, at times a gallop rhythm and a palpable and audible friction rub if the anterior surface of the heart is the site of infarction

HYPERTENSIVE HEART DISEASE

Definition Cardiac disease eventually developing from sustained hypertension, a development in middle age and beyond, commonly accompanied by a degree of arteriosclerotic heart disease ending in coronary insufficiency or congestive heart failure

Pathology Hypertrophy of the ventricular myocardium, degenerative changes in the muscle fibers, disease of the coronary vascular tree

Physical Signs *Inspection* Prominence of the precordium, a PMI usually in the sixth interspace well toward or in the anterior axillary line at times beyond, a heaving rather diffuse apex beat *Palpation* Confirmation of the displaced and heaving PMI *Percussion* The left border of dulness in the axillary line or beyond in the fifth and sixth interspaces *Auscultation* In the absence of failure, a loud mitral first sound (at times booming), accentuation of the aortic second sound, a blowing systolic murmur, its maximum at the apex, with radiation over the precordium and to the left, rarely a faint blowing early diastolic murmur at the aortic area radiating down the left border of the sternum in the case of long standing high grade hypertension *Pulse* Thickened radial arteries a pulse wave difficult to compress a sharp strong pulse wave *Blood Pressure* Ranging from a systolic level of from 180 to 260 or more mm of mercury a diastolic level of from 110 to 160 mm the hypertension being predominantly systolic or diastolic dependent upon etiologic factors

Remarks Congestive failure will be first of the left ventricular type, later, right heart failure will develop Auricular fibrillation may occur

* Though this disturbance of conduction is rare it occurs more commonly in this form of heart disease than in any other

RHEUMATIC HEART DISEASE

Definition Rheumatic fever, a systemic disease of infectious origin is accompanied by a high incidence of damage to the heart muscle and the valves through tissue sensitivity to bacteria or their products

Pathology An inflammatory process in the myocardium characterized by the Aschoff body, an endocarditis, especially of the heart valves characterized by vegetations in the acute stage and resulting upon healing in scarring and deformity of one or several valves, a pericarditis healing with adhesions of the pericardial layers and to structures outside the pericardial sac

RHEUMATIC CARDITIS

Physical Signs *Inspection* General or systemic manifestations at times such as rashes rheumatic nodules (Fig 66 page 714), a PMI often diffuse possibly slightly or moderately displaced to the left in the fifth interspace *Palpation* Confirmation of a diffuse apex beat suggestive of a weak thrust against the hand *Percussion* A left border displaced to the left between the midclavicular and anterior axillary line or as far to the left as the latter, in the fourth and fifth interspaces occasionally a percussible right border *Auscultation* Heart sounds of poor quality, at times of a tick tock type a soft blowing systolic murmur of relative mitral insufficiency due to ventricular dilatation and/or organic insufficiency as the result of endocarditis of the mitral valve tachycardia often premature contractions, less often partial heart block and auricular fibrillation *Pulse* A weak pulse wave and rhythm disturbances as noted *Blood Pressure* Normal or lowered

Remarks The signs listed are those commonly appearing if the acute myocarditis is of such a degree as to give clinical symptoms More commonly during acute rheumatic infection only tachycardia may be noted clinically Commonly the electrocardiogram shows conduction disturbances especially those of incomplete atrioventricular (first degree) block Pericarditis may be present

RHEUMATIC VALVULAR DISEASE

This represents valvular disease either with or without active rheu

matic fever Burch and Reaser state that the symptoms and signs of valvular disease are encountered in the following descending order of frequency

1 Mitral insufficiency
2 Mitral stenosis
3 Mitral insufficiency and aortic stenosis
4 Mitral stenosis and aortic insufficiency
5 Tricuspid insufficiency or stenosis and any combination of or all of the above valve lesions

MITRAL DISEASE

INSUFFICIENCY

Physical Signs *Inspection* An apex beat in the fifth interspace displaced slightly or moderately to the left *Palpation* In the absence of failure an impact of good strength *Percussion* Displacement of the left border slightly to moderately toward the anterior axillary line in the fourth and fifth interspaces *Auscultation* Heart sounds of good quality a blowing, at times harsh systolic murmur heard at its loudest at the apex transmitted toward the axilla and over the precordium, not influenced by position, tachycardia only with failure *Pulse* Normal *Blood Pressure* Normal

STENOSIS

Physical Signs *Inspection* A dusky flush over the cheeks, the apex beat commonly in normal position *Palpation* As in insufficiency, with high grade stenosis a late diastolic thrill sharply localized at the apex *Percussion* In thin patients, at times lateral displacement of dulness in the third left interspace due to a dilated left auricle, in some patients a percussible right heart border due to right ventricular hypertrophy *Auscultation* A sharply localized apical low pitched *rumbling murmur beginning in mid diastole, crescendo in type,* to end in a snapping mitral first sound accentuation of the pulmonic second sound in high grade stenosis rarely a soft, high pitched early diastolic blow at the pulmonary area transmitted downward along the left sternal border (Graham Steell murmur) *Pulse* Normal *Blood Pressure* Normal or that of relative hypotension in the younger decades of life

Remarks The differentiation of the murmur of mitral insufficiency from a physiologic murmur and from relative mitral insufficiency is important Stenosis is usually attended by some degree of insufficiency, therefore the murmurs of both defects may be present When auricular fibrillation supervenes, the murmur of mitral stenosis disappears in the occasional case but more commonly is heard as an early diminuendo diastolic murmur The congestive failure of mitral stenosis will be of the right heart type (Rheumatic valvular disease offers the commonest site for the development of subacute bacterial endocarditis The signs of embolic phenomena in this disease have been cited elsewhere in this book)

AORTIC DISEASE

Stenosis

Physical Signs *Inspection* Commonly pallor prominence or bulging of the precordium an apex impulse in the sixth interspace well toward or in the anterior axillary line (in later years of the disease in the midaxillary line or beyond) of a moderately diffuse heaving type *Palpation* Confirmation of a slow strong heaving PMI a systolic thrill at the aortic area commonly transmitted to the right infraclavicular area and to the vessels of the neck *Percussion* A left border well to the left in the sixth fifth and fourth interspaces even as far as the midaxillary line a percussible right border because of the great total heart size *Auscultation* In the absence of failure heart sounds of good quality a blowing systolic murmur at the apex transmitted toward the axilla and over the precordium (due to either relative and/or organic mitral insufficiency) a harsh systolic murmur at the aortic area transmitted to the right infraclavicular area and to the neck often a sinus bradycardia *Pulse* Slow with a pulse wave of the plateau type *Blood Pressure* Commonly presenting low systolic and high diastolic levels with a small pulse pressure

Insufficiency

Physical Signs *Inspection* As in stenosis *Palpation* A rather diffuse heaving impulse in the sixth interspace well to the left extremely rarely a diastolic thrill at the base of the heart (aortic area

and just to the left of the sternum in the second and third interspaces) *Percussion* As in stenosis *Auscultation* At the apex, as described above in aortic stenosis, in instances of free regurgitation, occurring more often in syphilitic disease (see below), the Austin Flint murmur, at the base, a high pitched early diastolic murmur at the aortic area often best heard in the third interspace to the left of the sternum, and if transmitted farther, along the left sternal margin to the apex *Pulse* A wave of rapid rise and fall (Corrigan pulse), clear cut capillary pulse in instances of *free* aortic insufficiency *Blood Pressure* Essentially normal or moderate systolic hypertension, in instances of free insufficiency, systolic hypertension diastolic hypotension, and a large pulse pressure

Remarks If aortic stenosis is present some insufficiency is also present Therefore both murmurs are commonly heard, though in high grade stenosis the diastolic murmur may not be heard The degree of valvular incompetency determines the absence or presence of peripheral signs Failure in aortic disease will be first of the left ventricular type

SYPHILITIC HEART DISEASE

Definition A complication of aortitis appearing as incompetency of the aortic valve apparent one to two decades after infection, eventually ending in left ventricular failure

Pathology Dilatation of the root of the aorta, sagging of the valve commissures and rolling of the borders of the valve cusps productive of incompetency, left ventricular hypertrophy

Physical Signs *Inspection* With free regurgitation systolic nodding of the head, pulsation of peripheral arteries and *in the suprasternal notch*, prominence or bulging of the precordium an apex beat diffuse and heaving impulse in the sixth interspace toward the anterior axillary line or beyond *Palpation* Confirmation of the diffuse, heaving powerful apex thrust very rarely an early diastolic thrill at the cardiac base in the second interspace on the right side and third on the left side palpable pulsation in the suprasternal notch due to dilatation of the aortic arch *Percussion* A left heart border at the anterior axillary line or beyond in the sixth, fifth and fourth interspaces, a percussible right heart border because of the total cardiac

enlargement, frequently retrosternal dulness in the second and third interspaces on the left or right side or on both because of dilatation of the aortic arch *Auscultation* In the absence of failure heart sounds of good quality or loud a blowing systolic murmur at the apex transmitted to the axilla and over the precordium due to relative mitral insufficiency, in free aortic incompetency a low pitched, rumbling mid diastolic murmur at the apex (the Austin Flint murmur), at the aortic area the blowing high pitched early diastolic murmur * often heard best in the third interspace to the left of the sternum and transmitted along the left sternal border to the apex the Duroziez murmur over large peripheral arteries *Pulse* A wave of rapid rise and fall (Corrigan s pulse) a capillary pulse *Blood Pressure* Normal or moderate systolic hypertension in free regurgitation a systolic hypertension diastolic hypotension (190/50) a large pulse pressure

Remarks The diagnosis of aortitis without aortic insufficiency or aneurysm is so questionable that it will not be considered in this book Aortic insufficiency progresses eventually to left heart failure

THYROTOXIC HEART DISEASE

Definition Disturbance in cardiac function in the presence of toxic thyroid states

Pathology Commonly hypertrophy and dilatation difficult of explanation

Physical Signs *Inspection* In many the facies and appearance of toxic thyroid disease a sharply localized quick PMI in some instances displaced laterally in the fifth interspace pulsation of the peripheral vessels *Palpation* Confirmatory of the sharp apical thrust of the heartbeat *Percussion* A left border possibly between the midclavicular and the anterior axillary lines in the fourth and fifth interspaces *Auscultation* Heart sounds active and of good quality a blowing systolic murmur at the apex possibly of relative mitral insufficiency a sinus tachycardia at times auricular flutter auricular fibrillation or premature contractions commonly *Pulse* Rapid and

* Rarely the murmur has a musical cooing quality possibly due to a tear in the valve since it is characteristically heard in traumatic aortic insufficiency

bounding *Blood Pressure* A systolic hypertension, with normal or decreased diastolic pressure, an increased pulse pressure

Remarks The eventual development of auricular fibrillation commonly occurs Congestive heart failure may develop

HYPOTHYROID HEART DISEASE

Definition A disturbance in cardiac function associated with myxedema

Pathology Degenerative changes of the myocardium, arteriosclerosis in the coronary artery bed, commonly pericardial effusion

Physical Signs *Inspection* Often no visible apex beat *Palpation* Often no palpable apex impulse or one of faint degree *Percussion* From slight to marked cardiac enlargement, to the left and right *Auscultation* Heart sounds weak muffled in quality at times of the embryocardia variety, systolic blowing murmurs at the apex, over the precordium and at the base *Pulse* Slow *Blood Pressure* Hypotension usually present

Remarks Many of the physical findings may actually be those of the pericardial effusion which is frequently present The murmurs are probably of hemic origin, and of relative mitral insufficiency due to ventricular dilatation Though hypotension is the usual change to expect so far as the blood pressure is concerned in the older age groups hypertension is not unusual, owing to coincident essential hypertension or arteriosclerosis

HEART DISEASE DUE TO MYOCARDIAL DEGENERATION OR MYOCARDITIS

Definition Disordered cardiac function may occur as the result of degenerative changes in the myocardium due to anemia nutritional deficiency, prolonged fever, debilitating diseases, and toxic infections as in diphtheria

Pathology Usually evidence of chronic myocardial degeneration

Physical Signs *Inspection* A PMI either absent or diffuse and weak, often some displacement laterally in the fifth interspace *Palpation* Confirmatory of poor myocardial tone, an apex impulse not palpable, or one diffuse and with a weak thrust *Percussion*

Often a left border displaced laterally in the fourth and fifth interspaces *Auscultation* Heart sounds often of poor quality, *muffled*, distant and weak embryocardia' at times, occasionally a gallop rhythm often sinus tachycardia a systolic murmur at the apex and base *Pulse* Weak of low tension tachycardia, at times capillary pulse and Corrigan type of pulse wave *Blood Pressure* Hypotension

Remarks All the signs are those of a flabby myocardium lacking strength The Corrigan and capillary pulses are indicative of poor vascular tone and peripheral vasodilatation

PERICARDITIS

Definition Inflammation of the pericardial surfaces with or without effusion healing without residue or followed by adherence of the pericardial surfaces and of the pericardium to mediastinal structures and the chest wall

Pathology Fibrinous or serofibrinous pericarditis appearing in uremia myocardial infarction collagen disease and in inflammation of rheumatic or tuberculous types purulent pericarditis occurring with pyogenic infection later organization of exudate leading to adhesive pericarditis in instances due to infectious inflammation

Fibrinous Pericarditis

Physical Signs *Inspection* Normal *Palpation* Characteristically only the friction rub to-and fro with the cardiac cycle felt in the fourth and fifth interspaces to the left of the sternum *in the portion* not covered by lung *Percussion* Normal *Auscultation* A to-and fro rub with systole and diastole to the left of the sternum in the fifth fourth and at times third interspaces *Pulse and Blood Pressure* Normal

Remarks Only the signs of fibrinous pericarditis have been listed assuming there are no other cardiac abnormalities Usually of course, the fibrinous pericarditis occurs in hearts diseased otherwise For example the friction rub over an infarcted area of myocardium will be accompanied by signs of hypertensive or arteriosclerotic heart disease or the signs and symptoms of carditis may be present in acute rheumatic fever

Pericarditis with Effusion

Physical Signs *Inspection* If minimal or moderate, nothing remarkable, if massive (*cardiac tamponade*) because of pressure on the venae cavae, distention of the cervical veins, persistent in the upright position, occasionally, edema of the face, neck, and upper extremities, movement of left costal margin medially on inspection (Hoover s sign) *Palpation* Weak or absent apex beat, usually no friction rub except in the recumbent position with shifting of fluid posteriorly *Percussion* Absence of relative cardiac dulness, instead absolute dulness, increased dulness to left, extent dependent upon the amount of fluid even to the postaxillary line, dulness to the right, a triangular area of cardiac dulness, apex upward, in massive effusion, dulness at the left lower chest posteriorly in massive effusion *Auscultation* Heart sounds distant or absent friction rub present if fluid moderate and posteriorly, Ewart s sign *Pulse* Often weak and of small volume, a *paradoxical pulse* a weaker and smaller pulse wave during inspiration (cause unknown) *Blood Pressure* A relative hypotension

Remarks These physical findings will vary greatly with the amount of pericardial effusion With small amounts, the physical signs may be little more than with fibrinous pericarditis In high grades of cardiac tamponade signs of engorgement in the peripheral venous system may be marked with distention of cervical veins, edema of the face and upper extremities hepatic enlargement due to congestion and ascites may develop as well as edema of the lower extremities and genitalia

Hydropericardium noninflammatory and thus of nonfibrinous type occurring in nephrosis nutritional disease myxedema and the like will give the same signs depending upon the amount of fluid

Constrictive Pericarditis (and Concretio Cordis)

Physical Signs *Inspection* Engorgement of the cervical veins at times facial cyanosis often a weak or absent apical beat systolic retraction of the apical region and precordium in the presence of extensive anterior adhesions rarely systolic retraction of left lower ribs in the midaxillary or postaxillary lines (Broadbent s sign) *Palpation* Confirmatory of inspection *Percussion* Borders of a smaller

or normal heart in concretio cordis at times enlargement to the left *Auscultation*. Normal at times a split, second sound at the pulmonic area *Pulse* Often of the paradoxical type, as noted under Pericarditis with Effusion *Blood Pressure* A relative systolic hypotension and resultant small pulse pressure

Remarks Hepatomegaly ascites and edema may occur as was indicated in the case of pericarditis with effusion. Occasionally, clubbing of the fingers occurs

CONGENITAL HEART DISEASE*

Definition A variety of congenital anomalies occasionally appearing in the physician s practice and causing circulatory dysfunction

Pathology Lesions indicated by nomenclature

Interauricular Septum Defect

Physical Signs *Inspection* Normal (Cyanosis only if the defect is great) *Palpation* Normal apex beat at times a diastolic thrill over the sternum at the level of the second intercostal space *Percussion* Normal at times occasionally maximal enlargement *Auscultation* A harsh systolic murmur at times a diastolic murmur at the same site as the thrill noted above again no murmur

Remarks Cyanosis and murmurs may vary with posture

Interventricular Septum Defect

Physical Signs *Inspection* Cyanosis only in the presence of a large defect *Palpation* A systolic thrill in the third and fourth interspaces to the left of the sternum *Percussion* Normal *Auscultation* A harsh systolic murmur at the same site (Roger s area) as the thrill

Pulmonary Stenosis

Physical Signs *Inspection* Cyanosis *Palpation* A systolic thrill at the pulmonic area *Percussion* Normal *Auscultation* A loud harsh systolic murmur at the pulmonic area at times a diastolic blow at the same site and at the left border of the sternum

* Only several of the commoner types will be considered

Multiple Congenital Anomalies

Certain combinations of congenital anomalies give rise to syndromes readily recognized clinically

Eisenmenger s Syndrome

If the interventricular septal defect is large and there is dextroposition of the aorta, it constitutes the Eisenmenger complex Thus,

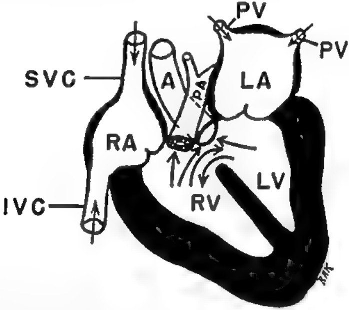

Fig 37 Schematic illustration of combined congenital anomalies of Fallot syndrome Large interventricular septal defect overriding of aortic orifice pulmonary stenosis and right ventricular hypertrophy (First two anomalies are basis for Eisenmenger syndrome)

the aortic orifice overrides the septal defect, and blood may pass from the right ventricle into the aorta as well as from the left ventricle The blood in the systemic circulation thereby contains some unoxygenated blood and cyanosis and clubbing of the fingers are the result

Tetralogy of Fallot

In this syndrome there is the Eisenmenger picture complicated by pulmonary stenosis and hypertrophy of the right ventricle The latter accounts for a greater admixture of nonoxygenated blood with

that from the left ventricle than in the Eisenmenger syndrome (Fig 37) Therefore the cyanosis and clubbing of the fingers are greater The picture of the Fallot syndrome is said to account for about 90 per cent of the instances of congenital cardiac defects with cyanosis and clubbing of the fingers It is compatible with longevity

Patent Ductus Arteriosus

Physical Signs *Inspection* Normal *Palpation* A systolic thrill over the pulmonic area *Percussion* Normal *Auscultation* A continuous murmur throughout systole and diastole (a machinerylike murmur) *Blood Pressure* A high systolic and relatively low diastolic pressure a high pulse pressure

Coarctation of the Aorta

Physical Signs *Inspection* Pulsating collateral arterial circulation the intercostal internal mammary and interscapular arteries *Palpation* A thrill at the base of the heart *Percussion* Normal or enlargement to the left *Auscultation* A systolic murmur at the base and at times in the left interscapular area *Blood Pressure* Hypertension in the arms lower pressure in the lower extremities

ANEURYSM OF THE AORTIC ARCH

Definition A blood or clot filled mediastinal tumor arising from the aorta compressing one or several mediastinal or intrathoracic structures

Pathology Practically always a complication of syphilitic aortitis

Physical Signs *Inspection* Pulsation in the third, second, and first interspaces on either or both sides or in the left interscapular area and/or in the suprasternal notch, at times, bulging of the chest wall rarely tumor formation *Palpation* Confirmatory as regards pulsation and bulging at times a systolic thrill at times a diastolic shock *Percussion* Widening of the cardiac dulness to the left in the third interspace dulness to the right in the third second and at times in the first interspaces and/or on the left or in the left interscapular area *Auscultation* At times systolic murmur over the site of the sac as indicated by the other signs *Pulse* Inequality of the

pulse waves of the two radial arteries at times and rarely even absence in one *Blood Pressure* Differences in the levels of the two sides greater than 15 mm occasionally

Remarks An aneurysmal sac may by pressure produce abnormal physical signs over the lung areas and in the neck, Horner s syndrome because of pressure upon the sympathetic ganglion chain, other neurologic phenomena because of pressure effects

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14. THE ABDOMEN—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

THE EXAMINATION OF the abdomen by the usual methods of physical examination is less satisfactory than the examination of the heart and lungs The limitation of adequate and satisfactory examination technics the manner in which the abdomen is sealed off and the lack of peripheral accessory findings all conspire to make this portion of the physical examination frequently so unsatisfactory In examination of the heart the correlation of inspection palpation percussion and auscultation makes diagnoses of heart disease comparatively easy in the great majority of instances without the use of special methods of examination Diagnosis of pulmonary disease is also quite adequate in many cases from the history and examination without the use of the x ray examination In the case of abdominal disease however the physical examination is of less assistance the history being the more important The use of x ray examinations employing contrast media offers a modern aid in diagnosis which has become highly refined The importance of history taking is again well illustrated by the fact that the majority of persons having abdominal complaints have no organic disease of the abdominal organs and therefore the physical and x ray examinations are negative

ABDOMINAL REGIONS

As in the topography of the chest so in the consideration of the abdomen some system descriptive of areas or location in the abdomen must be utilized This is essential in the description of the location of symptoms or signs

pulse waves of the two radial arteries at times and rarely even absence in one *Blood Pressure* Differences in the levels of the two sides greater than 15 mm occasionally

Remarks An aneurysmal sac may by pressure produce abnormal physical signs over the lung areas and in the neck, Horner s syndrome because of pressure upon the sympathetic ganglion chain, other neurologic phenomena because of pressure effects

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11 MORAGUES VINCENT AND LYNXWILER CHESTER P Cardiac Anomalies A Clinicopathologic Correlation The Williams & Wilkins Co Baltimore 1954

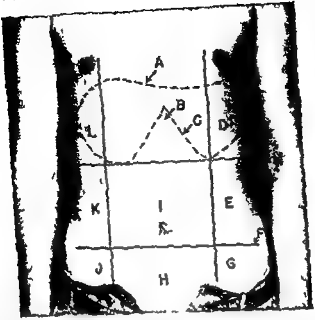


Fig. 2 Abdominal areas *A* Dome of diaphragm *B* Epigastric area *C* Costal margins *D* Left hypochondriac area. *E* Left lumbar area. *F* Anterior superior iliac spine *G* Left iliac area *H* Hypogastric area. *I* Umbilical area *J* Right iliac area *K* Right lumbar area *L* Right hypochondriac area

Right Upper Quadrant

Liver and gallbladder
Pylorus
Duodenum
Head of pancreas
Right adrenal gland
Portion of right kidney
Hepatic flexure of colon
Portions of ascending and transverse colon

Left Upper Quadrant

Left lobe of liver
Spleen
Stomach
Body of pancreas
Left adrenal gland
Portion of left kidney
Splenic flexure of colon
Portions of transverse and descending colon

Right Lower Quadrant

Lower pole of right kidney
Cecum and appendix
Portion of ascending colon
Bladder (if distended)
Ovary and salpinx
Uterus (if enlarged)
Right spermatic cord
Right ureter

Left Lower Quadrant

Lower pole of left kidney
Sigmoid colon
Portion of descending colon
Bladder (if distended)
Ovary and salpinx
Uterus (if enlarged)
Left spermatic cord
Left ureter

Loops of small bowel are found in all quadrants

Quadrants The most common method of subdividing the abdominal area is by the simple method of dividing it into quadrants This is done by dropping a perpendicular line from the tip of the sternum to the pubic bone through the umbilicus, and by a horizontal

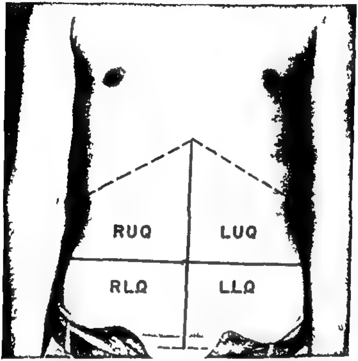
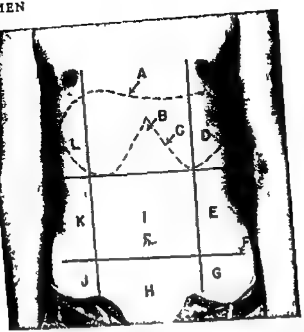


Fig 1 Abdominal areas *RUQ* Right upper quadrant *LUQ* Left upper quadrant *RLQ* Right lower quadrant *LLQ* Left lower quadrant.

line crossing the other at the umbilicus Thus the abdominal area is subdivided into *right* and *left upper quadrants* (R U Q and L U Q *) and *right* and *left lower quadrants* (R L Q and L L Q *) respectively (Fig 1)

The student should apply his anatomical knowledge in visualizing the organs which lie in the several quadrants This is necessary in determining the probable origin of pain tenderness and tumors The contents are essentially as follow in the absence of disease The effect of constitution upon the position of the abdominal viscera should not be forgotten (see Figs 8 12 13 pages 49 53 54)

* These abbreviations are commonly acceptable in the description of physical findings



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Right Upper Quadrant

Liver and gallbladder
Pylorus
Duodenum
Head of pancreas
Right adrenal gland
Portion of right kidney
Hepatic flexure of colon
Portions of ascending and transverse colon

Right Lower Quadrant

Lower pole of right kidney
Cecum and appendix
Portion of ascending colon
Bladder (if distended)
Ovary and salpinx
Uterus (if enlarged)
Right spermatic cord
Right ureter

Left Upper Quadrant

Left lobe of liver
Spleen
Stomach
Body of pancreas
Left adrenal gland
Portion of left kidney
Splenic flexure of colon
Portions of transverse and descending colon

Left Lower Quadrant

Lower pole of left kidney
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Division into Nine Sections Less commonly, the abdominal area is divided into nine sections Two imaginary parallel horizontal lines cross the lowest border of the costal margin and the anterior superior spine of the iliac bones (the *subcostal* and *bispinal lines* respectively) The two vertical lines essentially are lines dropped from the midclavicular line to the middle of Poupart's ligament, approximating the lateral borders of the abdominal recti muscles The nine areas are named the right and left *hypochondriac lumbar* and *iliac* or *inguinal* areas, in the center between these and beginning above are the *epigastric*, *umbilical* and *hypogastric* regions (Fig 2)

The contents of the abdomen underlying these nine areas are as follows

Left Hypochondriac
- Stomach
- Spleen
- Tail of pancreas
- Splenic flexure of colon
- Upper pole of left kidney
- Suprarenal gland

Epigastric
- Pyloric end of stomach
- Duodenum
- Pancreas
- Aorta
- Portion of liver

Right Hypochondriac
- Right lobe of liver
- Gallbladder
- Part of duodenum
- Hepatic flexure of colon
- Part of right kidney
- Suprarenal gland

Left Lumbar
- Descending colon
- Lower half of left kidney
- Parts of jejunum and ileum

Umbilical
- Omentum
- Mesentery
- Transverse colon
- Lower part of duodenum
- Jejunum and ileum

Right Lumbar
- Ascending colon
- Lower half of right kidney
- Part of duodenum and jejunum

Left Iliac
- Sigmoid colon
- Left ureter
- Left spermatic cord in male
- Left ovary in female

Hypogastric
- Ileum
- Bladder
- Pregnant uterus

Right Iliac
- Cecum
- Appendix
- Lower end of ileum
- Right ureter
- Right spermatic cord in male
- Right ovary in female

Examination of the back below the tenth rib is also to be included in the examination of the abdomen since changes here are related often to abdominal disease

Anatomical Landmarks Certain anatomical landmarks are com
monly and conveniently used in describing the location of pain
enderness and other abnormal findings These are the *subcostal margins* outlining the lower borders of the thoracic cage the *epi
gastric hollow* is located at the tip of the sternum The *midline* is
the anatomic linea alba extending from sternum to pubic bone The
umbilicus is an obvious convenient landmark, and marks the fourth

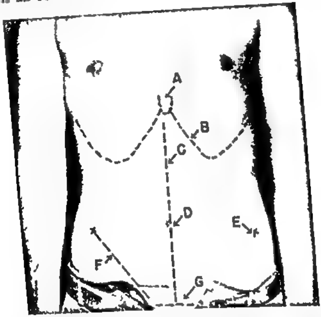

Fig 3 Landmarks of abdomen *A* Ensiform process of sternum. *B* Costal margin *C* Midline *D* Umbilicus *E* Anterior superior iliac spine *F* Poupart s ligament. *G* Superior margin of os pubis

lumbar vertebra The *lateral borders* of the *abdominis recti* muscles are helpful in describing certain physical findings *Poupart s ligaments* at the lower levels of the abdomen are structures to which findings may be related Of bony landmarks the *anterior superior spine* of each iliac bone are commonly used (Fig 3) Posteriorly the *eleventh* and *twelfth ribs* and the *costovertebral angle* are used as landmarks

Technics of Examination Examination of the abdomen involves the use of the four time honored technics inspection palpation per

cussion, and auscultation The latter has the least application in routine examination, though occasionally is of great value as will be noted in the following chapter

Position in Examination Commonly, the abdomen is examined with the patient in the recumbent or *supine* position This being the usual position, the student all too frequently thinks of this as the only

Fig 4 Knee-chest position The undraped subject is used to show the thighs perpendicular to the table the upper portion of chest resting on table

position for examination Under some circumstances it may be well to study the abdomen with the patient in the *standing erect* position, in the *sitting* position or in the *lateral* position that is, lying on one or the other side The erect position is best in examination for hernias in the lower abdomen since the organs drop by gravity to increase lower abdominal pressure and thus accentuate herniations Occasionally, something may be gained by having the patient assume either the *knee chest* position or one on the *hands and knees* (Fig 4)

INSPECTION

With the patient lying supine, the abdomen should be observed from above that is with the examiner standing at the bedside or beside the examining table The abdomen should be in a full light It may be well for the observer to move about a bit so that the abdomen may be observed from several angles This permits its study by the use of incidental shadows which may bring out variations of the contour as will be shown in the succeeding chapter

In addition it is wise to study the abdomen also from a seated position at the bedside The examiner should be so seated that his eyes are on a plane horizontal with the abdomen or again slightly above it so that the view may be at an oblique plane (as in Fig 14 page 300 as applied to the chest examination)

Skin In inspection of the abdomen attention is given first to the skin. As with the chest a relatively large expanse of skin usually unmodified by the tanning of exposure is available for inspection In addition to a search for abnormalities of the skin note is made of the venous pattern In thin white skin a tracery of veins is usually visible It must be recognized that with the loss of subcutaneous elasticity in advancing age veins may be prominent and actually protrude above the general level of the skin without indicating disease

Pubic Hair The pattern of the distribution of pubic hair on the abdomen is noted upon inspection The normal pattern in the male forms a triangle the base being at the pubic bone the apex at the umbilicus In the normal woman the pubic hair extends up to a horizontal line slightly above the level of the pubic bone The luxuriance or sparseness of pubic hair in either sex varies greatly within normal limits It depends to some extent upon the degree of hairiness in general and also upon whether the subject is a blonde or brunette In the latter the pubic hair is commonly more profuse

Respiratory Movement Abdominal movement with respiration is noted It must be recalled that in the female whose respiration is mainly costal little movement of the abdominal wall occurs In the male breathing quietly the major respiratory movement will be abdominal

Contour In the absence of disease inspection will show that comparable areas of the abdomen are symmetrical in contour and appear

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In the earlier years of life and in the very thin the *umbilicus* is at the level of the skin or slightly pouting With the accumulation of subcutaneous fat as the patient becomes older, the umbilicus lies at the bottom of a depression and usually is not visible

PALPATION

This method of examination was applied in the study of the chest mainly for the demonstration of vibration—tactile fremitus—though its use was also described for the localization of tenderness to the chest and evaluation of swellings In the examination of the heart, palpation was used similarly On the other hand in examination of the abdomen palpation is of much greater value By this technic normal organs or abnormal masses may be felt Furthermore it has the essential use of mapping out areas of tenderness through pressure applied by the examiner s fingers

Technic The subject is usually examined in the recumbent position He should be as relaxed as possible to permit palpation through the abdominal muscles If these cannot be relaxed examination may be made easier if the subject flexes his knees Since some patients tend to tense the muscles of the abdominal wall if the mind is fixed on the examination it is well at times for the observer to converse with the patient during the examination In this way the muscles may be relaxed If it is imperative that palpation be adequate and the abdominal muscles cannot be relaxed a hot tub bath may be a worthwhile adjunct Twenty minutes in a bath tub of hot water may give the needed relaxation the patient being examined while he is reclining in the tub Rarely anesthesia may be required for relaxation to permit satisfactory palpation of the abdomen

It is essential that the examiner develop and use the proper technic to obtain the maximum results from palpation The examiner s hands must be warm Cold applied to the abdomen causes reflex tensing of the abdominal musculature The physician coming into the home from out of doors in cold weather should warm his hands in hot water or otherwise before beginning his examination

It is imperative that the clinical clerk and the physician keep their fingernails trimmed to such a degree that as they use their finger tips in deep palpation no fingernail marks are left upon the abdominal wall If they do so the nails probably cause sufficient discomfort to

ance The significance of asymmetry will be discussed in Chapter 15

The contour of the abdomen as a whole is important, and should be described in the physical examination In general, the contour may be described as flat, rounded, or scaphoid

By *flat* is meant that the anterior abdominal wall extends essentially in a horizontal plane from the level of the rib margins to the pubic bone This is the usual contour in well developed and nourished youth, in the athletic and even in the spare elderly person who has an erect carriage Such a contour is maintained usually even if the subject stands upright

The *rounded* contour is one in which the abdomen presents a convexity to the horizontal plane as the body is observed from the side In the recumbent position, the height of the convexity is in the region of the umbilicus Commonly in the erect position, the height of the convexity shifts by gravity to a lower position between the umbilicus and the pubis The rounded abdomen is characteristic of young children If present in youth or in early adult life it results from an excess deposit of subcutaneous fat or from a lack of activity and muscle tone The rounded contour is more common in the female than male In the older decades of life there is a tendency to fat deposit in the subcutaneous tissues of the abdomen probably partially due to, and definitely accentuated by a decreasing tone of the abdominal muscles This permits a sagging of the abdominal wall due to intra abdominal pressure (the bay window of middle age)

The *scaphoid* contour is that in which the abdomen from the lateral view presents a concavity to the horizontal This is seen in the lean subject in all ages It is present especially in the spare old person

We must thus bear in mind that though the flat abdominal contour may seem to be the more normal or ideal, the other two contours within certain limits do not represent abnormal ones This is especially true as related to sex and age levels Only extremes of the rounded or scaphoid contours appear as manifestations of disease to be discussed later

In addition to the skin and contour of the abdomen in the normal person, little will be gleaned upon inspection However in the thin subject or in the one having a scaphoid abdomen it is not unusual to see the *pulsation* of the abdominal aorta This is systolic in time and located in midline cephalad to the umbilicus

lead to reflex hypertonicity of the abdominal musculature, at least in some instances

The movements of the palpating hand must be deliberate gentle, but firm This reduces tickling of the patient Sudden thrusts stimulate reflex muscle resistance thereby interfering with satisfactory examination

Light Palpation The first step in the examination should be a general survey of the abdomen by light palpation Using the distal phalanges of the fingers of the examining hand (the right hand in the right handed person) the abdomen is systematically explored by light pressure in a search for tumefactions but especially for increased tone of the abdominal muscles indicating underlying disease The order in which various areas are examined will vary with circumstances As a rule it is better to leave that region most under suspicion to the last Thus if the history indicates possible appendicitis it would be better to begin palpation in the left lower quadrant then to examine the upper areas of the abdomen palpating the right lower quadrant or the appendiceal region last Muscle resistance might be encountered only in the latter area

Deep Palpation After the survey with light or gentle palpation a systematic examination of the abdomen is made by deep palpation. Here also the fingers of one hand may be used (Fig 5) Under special circumstances the fingers of both hands may be employed the hands being held parallel to each other thus a larger area can be explored In deep palpation some clinicians prefer to use a technic in which both hands are used one on the other the topmost hand exerting the pressure the one beneath being used merely for tactile sensation * In this maneuver for the right handed student the distal phalanges of the fingers of the left hand are placed on the area to be examined the distal phalanges of the right hand are then applied to the fingers of the left hand pressure being applied by the right hand (Fig 6) The hands may however be interchanged

In deep palpation with whatever technic the pressure is applied by the examining fingers steadily and firmly If a well developed ab

* The reason for this technic is that firm pressure dulls the tactile sensitivity of the finger tips The student may test this by placing his fingers on an object and pressing very firmly The tactile sensation is thereby dulled

Fig 5 Technic of deep palpation

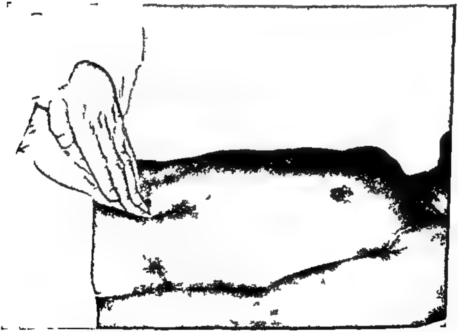

Fig 6 Technic of palpation by using both hands ; Pressure is applied by upper hand

a deep breath*, and as he does so the upper or right hand is permitted to ride with the abdominal wall With descent of the diaphragm on deep inspiration the liver moves downward and if it is to be palpated, it will be felt by the palpating fingers as they ride with the abdominal wall The liver edge is recognized by the finger tips as a firm ridge If the observer wishes thus to explore the whole liver edge, from the right anterior axillary line even to the left nipple line (in enlargement

Fig 7 Position of hands in palpating for liver

of the left lobe of the liver) the maneuver is repeated as often as necessary the right hand being shifted so as to palpate the various segments of the hepatic border

In bimanual palpation of the *spleen* the technic is quite similar The examiner s position is maintained as above The left hand reaches across the abdomen and is slipped under the flank of the patient in the same position as described in palpation for the liver The finger tips of the right hand are directed obliquely upward and laterally under the left costal margin in the region just lateral to the left mid

* When asking the patient to take a deep breath one must ask him to fill his lungs to obtain descent of the diaphragm otherwise he protrudes the abdomen which defeats the attempted maneuver

dominal musculature is present or if involuntary muscle resistance develops during examination, depth may be gained by the following procedure Pressure is made and the patient then is instructed to breathe deeply Upon inspiration the examining hand may lose a little ground, as the abdominal wall is protruded somewhat with descent of the diaphragm However, on expiration as pressure is maintained a greater depth is reached By this method, muscle resistance may be overcome when the examiner is searching for deep seated organs or tumors

In general in the absence of disease palpation is more difficult in the well developed, athletic young person because of the well developed tonic musculature A heavy deposit of subcutaneous fat obviously will interfere also with the probing fingers In women having had repeated pregnancies, in the sedentary middle aged person and usually in the aged, the tone of the abdominal musculature is so reduced as to make palpation easier

BIMANUAL PALPATION In using bimanual palpation for examination of the *liver* a maneuver somewhat as follows is carried out The examiner, facing the patient, stands or sits at the patient s right side as he is supine on the bed or table The left hand is slipped under the patient s flank the extended fingers, palm side up lying parallel to the ribs The hand should be so placed that the patient s eleventh and twelfth ribs lie on the examiner s hand (The patient must be in a relaxed state) By making upward pressure with this hand, the liver can be pushed toward the anterior abdominal wall to some extent or at least it is possible to prevent the backward displacement of the liver by the right hand which is making firm pressure on the abdominal wall When the left hand is in position at the back the right hand is placed flat on the abdomen the fingers being in the long axis of the body The finger tips are in the right upper quadrant at a level about one half way between the costal border and the level of the umbilicus (Fig 7) (If the finger tips are too close to the costal margin there is no opportunity for the fingers to ride with the respiratory movement of the abdominal wall) With the two hands placed as described the examiner is ready to carry out palpation for the liver Firm pressure is made by the right hand The patient is asked to take

the two hands If examination is successful, the kidney is felt as a solid mass of moderate firmness

The bimanual maneuvers usually are carried out after the general palpatory examination of the abdomen as described earlier, has been completed Such deep bimanual palpation usually leaves the abdominal muscles somewhat more tense for a short time

Fig 9 Position of hands in palpating for right kidney

The student should be aware of other methods useful in examination of the abdomen under special circumstances

USE OF GRAVITY If it is desirable to have gravity assist in bringing the liver down the so called Murphy maneuver may be used The examiner sits on the table or bed and the patient having sat up leans back against the examiner resting his back against the examiner s left chest The examiner s right hand is then passed around the patient s trunk under his right *arm the* fingers being hooked under the right costal margin Both hands may be used in this technic the examiner s arms encircling the patient s body The patient s muscles are thus quite relaxed and with the help of gravity the liver edge moves down to be more easily palpated by the examining fingers

clavicular line (Fig 8) (If the patient is examined from his left side, the hands are reversed in searching for the spleen) On deep inspiration, an attempt is made to feel the splenic tip as the organ is pushed down by the descending diaphragm

A modification of this technic is used in palpation for the *kidneys* The left hand under the flank is in a position lower than when exam

Fig 8 Position of hands in palpating for spleen

ining for liver or spleen the hand being placed parallel to but just below the twelfth rib The right hand on the abdomen is also placed lower so that the probing finger tips are in the lower quadrant below the level of the umbilicus The right is the palpating hand for both sides if the examination is carried out from the patient s right side (Fig 9) The left hand reaches across the abdomen to be placed at the flank in attempting palpation of the left kidney (If the left kidney is searched for from the patient s left side the right hand is placed at the back) The finger tips must be pressed in deeply and then be permitted to ride with the abdominal wall at the height of inspiration If the kidneys are to be felt as they are displaced down ward at the height of inspiration, they will slip between the fingers of

Light palpation generally reveals little in the absence of disease except the amount of subcutaneous fat The ticklish person shows the characteristic manifestations The abdominal muscles are abnormally tensed under such circumstances

In the well developed or muscular person palpation may readily demonstrate the *lineae transversae* of the recti abdominis muscles The novice must learn to recognize these and the muscle segments between them Most students at some time have described an abdominal tumor which was shown to be a segment of the rectus

Deeper palpation of the abdomen of the healthy person may demonstrate a number of structures which must be recognized as being not unusual and therefore should not be misinterpreted

In the epigastrium, the *aortic pulsation* is commonly felt as the palpating fingers press upon the vessel It lies against the rigid spine, and therefore the fingers feel the full thrust of the systolic pulsation (The young practitioner will be surprised how frequently a healthy adult will consult him after discovering the aortic pulsation The worried person will need to be reassured that only in death will the pulsation cease)

In palpation of the older person or the younger one with lax abdominal musculature or better still in the woman who has had numerous pregnancies it is not unusual to outline the *transverse colon* extending across the abdomen just above the umbilicus It is a soft movable structure The sigmoid colon is better and more commonly felt as a ropelike form in the left lower quadrant lying more or less parallel to Poupart s ligament It is movable and can be rolled under the palpating fingers Less commonly the cecum and a portion of the ascending colon can be felt as a somewhat similar structure in the right lower quadrant

To the chagrin of many a student and young physician, the normally distended bladder rising above the pubic rim as a grapefruit size tender firm mass has been considered an abdominal tumor Modest women especially may not wish to tell the examiner that they would like to empty the bladder which has been filling during the long wait in the reception room This is aggravated especially by the increased urinary secretion accompanying the nervousness in anticipation of the examination

Gravity also may assist in palpation for the spleen The patient is asked to lie on his right side, drawing his knees upward and bringing his shoulders forward The examiner stands or sits facing the patient The left hand is placed over the patient s left flank, as in the bimanual technic described above, pressure being made forward, the finger tips of the right hand are directed under the left costal margin The patient then takes a deep breath to force the spleen downward by descent of the diaphragm Gravity may aid in dropping the spleen more medially (Fig 10)

Fig 10 Technic for palpation of spleen in right lateral decubitus

The author has found repeatedly that a spleen only moderately enlarged has been made palpable by elevating the head and trunk slightly This is possible only on the adjustable hospital bed If the head section is raised from about 15 to 20 cm (6 to 8 inches), the spleen may drop sufficiently in the recumbent person to be palpable by the usual bimanual method when it could not be palpated before

Rarely the examiner may have the patient support himself on his hands and knees Deep seated tumors may thus be displaced toward the anterior abdominal wall by gravity The examiner s hands are applied in palpation from below

Findings in the Normal Abdomen Palpation of the abdomen in the healthy person may yield the following information

domen Bimanual palpation of the kidneys is accompanied by what some patients describe as a sickening pain akin to the discomfort of compressing a testicle

Examination of the Inguinal Rings In the male palpation of the inguinal rings is frequently carried out in routine examination in a

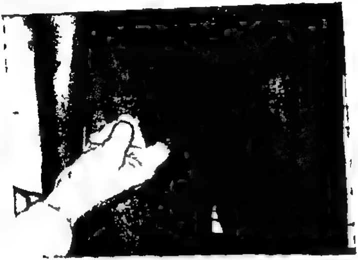

Fig 11 Technic in palpation for inguinal hernia

search for the presence of dilatation It is an absolute requirement in examinations for military service or industrial work This is accomplished in either the recumbent or the erect position The examiner s index finger is passed upward through the scrotal wall along the spermatic cord to the external inguinal ring (Fig 11) This is recognized by feeling the sharp edge of the aponeurosis of the external oblique muscle Normally this is about of such size that the tip of the index finger just fills it In searching for *hernia* here the subject is requested to cough and the presence or absence of an impulse against the finger is noted

PERCUSSION

This method of examination is used to extend the information gained by inspection and palpation or in some instances to act as a substitute for palpation because of certain limitations which will appear particularly in the next chapter

Less disconcerting, but as misleading is the apparent hard tumor at times described by the student at or just below the umbilicus and which he should recognize as the promontory of the *sacrum* This will not surprise him if he will recall the height to which it rose in the abdomen of his cadaver Remembering this he will realize that only a few loops of small bowel may separate the sacral promontory from the abdominal wall in the person with a scaphoid abdomen or in one with very relaxed muscles If this bony structure is easily felt, it is not unusual to trace the bifurcation of the aorta into the iliac arteries

Bimanual palpation in the healthy person may demonstrate several of the solid viscera (The *spleen* is not palpable normally)

Usually, the *liver* is not palpable in the asthenic, hyposthenic, or *even sthenic type of person if he has good muscle tone* In the latter constitutional type, the edge may be felt at the height of inspiration if the muscular wall is not too taut The wide subcostal angle and short chest of the hypersthenic person commonly permit the palpation of the liver edge a couple of centimeters or more below the costal border even upon quiet respiration With deep inspiration it may descend a couple of finger breadths and still not be indicative of disease Commonly, the lower border of the left lobe can be traced across the epigastrium in this type of person The liver edge is a firm ridge striking the fingers with little if any tenderness The edge of the normal liver should be quite sharp and of a regular and relatively straight contour

If the liver descends sufficiently for the examiner to feel some of its anterior surface it should be smooth

Only in the thin, young person with relaxed abdominal walls in the multiparous woman, or in the aged can the *kidneys* be felt upon bimanual palpation at the height of inspiration Only the lower pole or possibly the lower one half of the kidney can be felt to slip between the two hands as a solid rather firm but elastic mass Since the right kidney usually lies a bit lower than the left it is much more commonly palpable

Deep palpation of the normal abdomen though unaccompanied by the tenderness which may accompany disease is nevertheless associ ated with some discomfort In the epigastrium deep pressure causes appreciable discomfort This is less so in other portions of the ab

AUSCULTATION

From a practical standpoint it must be admitted that auscultation is rarely used in the routine examination of the abdomen In the absence of intra abdominal disease it is not particularly helpful Nevertheless the student should be familiar with the sounds which may be heard normally Sounds are produced by the contracting bowel musculature and by the onward passage of the bowel contents

Normally the sounds as heard with a stethoscope consist of a more or less continuous succession of clicks and gurgles Thorek relates their rate of appearance to the respiratory rate indicating that normally they should be somewhat more rapid than the respiratory cycles If slowed to the respiratory rate he classifies them as decreased Loud gurgles borborygmi as heard with the naked ear may be heard in the normal person at the time of physical examination This is especially true in persons whose nervous tension expresses itself in the gastrointestinal tract through the autonomic nervous system The splash of fluid in the stomach is often heard as the patient moves

In the latter months of pregnancy the obstetrician may give attention to the fetal heart sounds with the aid of a stethoscope

THE ABDOMINAL REFLEX

The abdominal reflex is one of the group of superficial reflexes It is observed at times as the examiner first places his hand on the abdomen However it is best demonstrated by stroking the skin rather lightly with a blunt object or the fingernail (page 38)

In the upper abdomen the instrument is used to stroke the skin quickly from the lateral portion toward midline about 2 5 cm (1 inch) or more below and parallel to the costal margin In the lower quadrants the instrument is brought toward midline 5 cm (2 inches) above and parallel to Poupart s ligament (Fig 12)

Normally the *upper* abdominal reflex results in muscular contraction which moves the abdominal wall toward the side stimulated, the umbilicus moving upward to some degree The *lower* reflex also moves the abdominal wall toward the stimulus, and the umbilicus is pulled downward

The presence of these reflexes indicates normal arcs related to the seventh to ninth dorsal segments for the upper and tenth and eleventh

Its technic and application are the same as in the examination of the chest and its contents The principles are no different, namely, the outlining of air containing or solid structures by a changing note

In fact in the chapter on the normal chest, it was indicated that liver dulness extends from about the fourth intercostal space to the costal margin Therefore the use of percussion to aid in determining the size of the liver is obvious If for some reason palpation, even in the normal person, is unsatisfactory as in a ticklish person percussion may be a second choice in determining not only the liver size but also its descent below the costal margin on deep inspiration (Palpation is always the preferable method of examination since it also gives information concerning hepatic consistency, regularity of the border etc [Fig 30, page 327])

Percussion may be used in an attempt to outline the spleen if palpation is unsuccessful in demonstrating splenomegaly In the supine position gastric tympany usually interferes with percussing the spleen in the normal person However, if the subject assumes the right lateral decubitus the spleen lies above the stomach and colon, and thus may be percussed as dulness from pulmonary resonance in the axilla obliquely and anteriorly to the costal border I find this successful in only a small minority of normal persons

Percussion of the kidney areas is not helpful in the healthy person On the other hand the distended bladder rising out of the pelvis can be mapped out by its dull note Likewise, the pregnant uterus after it has enlarged to above the pelvic brim offers a dull percussion note

Over the abdomen of the well person the percussion note is one of a varying degree of tympany with exception of the few possibly dull areas noted above This is to be anticipated since the percussion note is due to air contained in the gastrointestinal tract under varying tension, dependent upon the pressure maintained at a given moment by the visceral musculature For example, if the stomach is tensely distended it emits a ringing tympanitic note different from that of the rest of the abdomen This may permit the accurate outlining of the gastric contour Tympany of almost equal degree may be found over the cecum or hepatic or splenic flexures of the colon or over the sigmoid colon Otherwise, the tympany is more of the nonmusical flat' variety

Auscultation

From a practical standpoint it must be admitted that auscultation is rarely used in the routine examination of the abdomen In the absence of intra abdominal disease it is not particularly helpful Nevertheless the student should be familiar with the sounds which may be heard normally Sounds are produced by the contracting bowel musculature and by the onward passage of the bowel contents

Normally the sounds as heard with a stethoscope consist of a more or less continuous succession of *clicks and gurgles* Thorek relates their rate of appearance to the respiratory rate indicating that normally they should be somewhat more rapid than the respiratory cycles If slowed to the respiratory rate he classifies them as decreased Loud gurgles borborygmi as heard with the naked ear may be heard in the normal person at the time of physical examination This is especially true in persons whose nervous tension expresses itself in the gastrointestinal tract through the autonomic nervous system The splash of fluid in the stomach is often heard as the patient moves

In the latter months of pregnancy the obstetrician may give attention to the fetal heart sounds with the aid of a stethoscope

The Abdominal Reflex

The abdominal reflex is one of the group of superficial reflexes It is observed at times as the examiner first places his hand on the abdomen However it is best demonstrated by stroking the skin rather lightly with a blunt object or the fingernail (page 38)

In the upper abdomen the instrument is used to stroke the skin quickly from the lateral portion toward midline about 2 5 cm (1 inch) or more below and parallel to the costal margin In the lower quadrants the instrument is brought toward midline 5 cm (2 inches) above and parallel to Poupart s ligament (Fig 12)

Normally the *upper* abdominal reflex results in muscular contraction which moves the abdominal wall toward the side stimulated, the umbilicus moving upward to some degree The *lower* reflex also moves the abdominal wall toward the stimulus and the umbilicus is pulled downward

The presence of these reflexes indicates normal arcs related to the seventh to ninth dorsal segments for the upper and tenth and eleventh

segments for the lower reflex It is accepted that there is a cerebral reflex arc mediated through the pyramidal tracts In the presence of the relaxed abdominal musculature of the multiparous woman, in the aged, or the obese, or when the bladder is full, the abdominal reflex may not be demonstrable even in the absence of nervous system disease

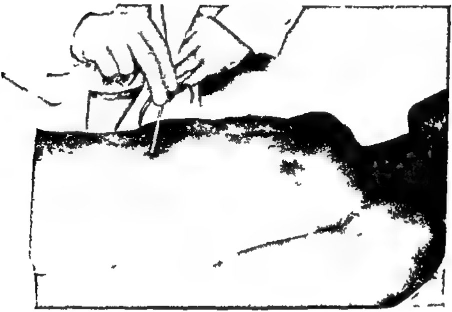

Fig 12 Technic for eliciting abdominal reflex

The Back

Examination of the back, exclusive of the spine should be considered with examination of the abdomen The back forms the posterior wall of the abdomen and therefore is intimately related to certain of the viscera Here our interest is in that part of the back extending from the tenth rib to the bones of the pelvis This includes the flanks also It is true that only occasionally is worthwhile information gained from examination of these regions *For that very reason they are so commonly neglected*

Inspection of the back is the primary and most important method of examination It consists essentially of recognizing the usual contours of the back and flanks and comparing the two sides from this standpoint

If possible it is best to inspect the back by observing the patient in the sitting position, the examiner standing behind the patient and looking from above downward From this vantage point one notes that in the normal subject the back in the lumbar area has curves in two planes Normally the spine presents some degree of lordosis or forward curvature at this level As one inspects the flanks from

Fig 13 Fist percussion of kidney area for deep seated renal tenderness

directly behind the subject a second (inward) curvature is seen in the line extending from the lower ribs to the crest of the ilium In the absence of disease or developmental abnormalities the contour of the two flanks should be equal and symmetrical

Palpation of the back is to make note of muscle resistance or spasm tenderness on deep pressure and to confirm any abnormality suspected upon inspection In palpation it is wise for comparative purposes to feel with each hand simultaneously

Percussion of the back normally produces a dull note At times it will be necessary to attempt to elicit tenderness deep in the renal region This may be done by striking the costovertebral angle region

with the closed fist—using the ulnar aspect of the hand rather than the knuckles, whose bony prominences would in themselves cause discomfort Since the beginner does not realize how light this blow should be, it is safer to use a modification of it The clenched left hand is laid with the ulnar side in the subject's costovertebral angle Then this fist is struck by the right hand clenched in the same manner (Fig 13) In this way the impulse is transmitted to the diseased area without setting up discomfort in the skin end organs as by a direct blow

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15. THE ABDOMEN—2

FINDINGS IN DISEASE

THIS CHAPTER WILL have as its purpose the description of the abnormalities which may be encountered in the abdominal examination in disease It will be necessary to introduce but few technics for examination not mentioned in the preceding chapter A few technics and maneuvers may be employed under certain circumstances which *would have no application except in the presence of specific abnor*malities Except for these variations the abdominal examination is carried out as has been described

In this chapter the first section will deal with examination of the ill person employing technics described in the preceding chapter This section will deal more or less in generalities

As in some of the foregoing chapters the second section by contrast will describe findings in specific disease states or syndromes The purpose of this plan is to give the student an overall picture of possible abdominal findings in certain diseases

INSPECTION

The Skin The skin of the abdomen presents a fairly large expanse for the observation of cutaneous abnormalities in general It may be a better site to study changes in the skin than the upper chest or face for example since exposure to the sun with attendant tanning is usually less

There is actually little need to discuss at this place the several skin diseases which have been named and described in the chapter on the skin Thus the tint of jaundice the discoloration of argyria hemochromatosis Addison's disease etc may be readily noted in the abdominal skin The macular papular vesicular and pustular rashes of the skin in general appear on the abdomen as well

with the closed fist—using the ulnar aspect of the hand rather than the knuckles, whose bony prominences would in themselves cause discomfort Since the beginner does not realize how light this blow should be, it is safer to use a modification of it The clenched left hand is laid with the ulnar side in the subject's costovertebral angle Then this fist is struck by the right hand clenched in the same manner (Fig 13) In this way, the impulse is transmitted to the diseased area without setting up discomfort in the skin end organs as by a direct blow

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In addition to the various cutaneous eruptions inspection of the skin of the abdomen may reveal other abnormalities

Pigmentation occurs under several circumstances Often with pregnancy a line of brown pigmentation (linea nigra) develops in the midline extending from the pubes to the umbilicus This is part

Fig ■ Photograph by infra red light of collateral circulation of lower chest and abdomen in portal cirrhosis

of the extensive pigmentation of pregnancy mentioned in Chapter 4 Commonly this persists after the pregnancy has been terminated though it may become more faint Irregular patches of rather faint pigmentation on the abdomen flank or back are commonly found in and suggest von Recklinghausen s disease (neurofibromatosis)

Several exceptions may be made relative to special skin lesions often limited to the abdomen Thus the *rose spots* of typhoid fever are commonly limited to the abdomen (They may appear on the back or may even be generalized) These appear as papules after the seventh day of the disease, are several millimeters in diameter reddish brown, and upon pressure with the palpating finger leave a brownish stain in the skin

FIG 1 Collateral venous circulation due to left sided hypernephroma with metastasis to liver and obstructive neoplastic invasion of portal vein (see also *Figs 23 24) Note also distended veins on right thigh and scrotum*

Scabies is commonly limited to the abdomen (The characteristics are described in Chapter 4) The umbilicus is a favorite spot for *fungus infection* (epidermophytosis) since it is an area difficult to keep clean and dry especially in fat people Secondary infection with a streptococcus provides the setting for a localized *erysipelas* in this region Very rarely may one encounter nodules localized at the navel *metastases* from intra abdominal lesions

sees striae most often not in disease but in the physiological state of pregnancy Here as the enlarging uterus stretches the abdominal wall, striae very frequently appear in the skin of the lower half of the abdomen especially laterally During the pregnancy, they are bluish,

Fig 4 Abdominal distention as result of fluid in tuberculous peritonitis (note prominence of lower abdomen in sitting position)

later persisting as white lines Next after pregnancy, striae are encountered most commonly in persons who are gaining weight rapidly A good example of such striae is seen in Cushing's syndrome because of the rapid deposition of fat in the pelvic girdle region The striae appear over the lower abdomen the flanks and upper thighs

Long continued pressure may lead to pigmentation This is frequently seen at the level of the belt, over the anterior superior spine of the ilium, and over the spinous process on the back in a thin person

The most common site for *striae* is the abdominal wall These represent areas where stretching and tearing of the subcutaneous

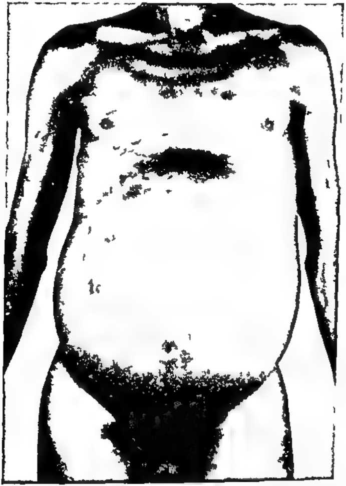

Fig 3 Abdomen distended by ascites and collateral venous circulation of lower chest and upper abdomen as result of portal cirrhosis

tissues have occurred as the skin in its various layers is put under tension Such striae usually extend in the long axis of the body (Fig 10 page 69) Fresh or recent ones are bluish because of increased vascularity As tension or stretching is relieved the blue color is lost, and the resulting scar tissue leaves the striae white The physician

in the veins of the abdominal wall (Fig 1) As shown in the illustrations the veins may reach the diameter of a pencil If of much lesser extent or merely suspected infra red photographs may demonstrate such collateral circulation (Fig 2) In inspection of the

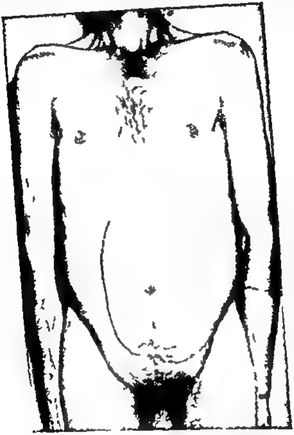

Fig 7 Fulness of left abdomen because of splenomegaly (outlined upon skin) of chronic myelogenous leukemia (see also Fig 4 page 259)

collateral circulation it is well to compress the veins to determine the direction of the venous flow With obstruction of the superior vena cava the blood from above finds its way to the heart via the inferior vena cava and thus the flow is downward (Figs 1 3, pages 342 344) In portal obstruction the flow is commonly upward to anastomose in part with the veins at the attachment of the diaphragm (Fig 3) Occa

The *scars* of past operations may give helpful clues to possible disease at the moment Thus a scar may indicate that certain organs have been removed Certain postoperative scars raise the possibility of adhesions and obstruction of the bowel The puckered scar indi

Fig 5

Fig 6

Fig 5 Abdominal distention due to pseudomucinous cystadenoma of ovary Note pouting of umbilicus

Fig 6 Bilateral hydronephrosis as cause of abdominal distention

ates that a drainage tube was used suggesting as an example that he gallbladder was drained and not removed

The *vascular supply* to the abdominal wall may reveal important ata upon inspection Because of obstruction in large intra abdominal r intrathoracic venous channels, a collateral circulation may develop

Movements of Respiration With respect to respiratory movements of the abdominal wall, disease may have significant effects In the presence of an inflammatory reaction in the peritoneum, the abdominal muscles and diaphragm may be so rigidly splinted as to

Fig 9 Tumefaction in epigastric area as result of pointing amebic abscess of left lobe of liver Hepatomegaly is outlined by adhesive tape (From author s medical service Louisiana State University Medical School and Charity Hospital New Orleans)

prevent movement Therefore in upper abdominal peritoneal irritation no abdominal respiratory movements will be seen and respiration is costal in type This may be a valuable diagnostic sign

Contour The contour of the abdomen may be significant In the chapter on the normal findings the contour was described as flat scaphoid or rounded The flat abdomen has no significance, the

sionally, one may see a pattern of short dilated veins at this level in the chest wall In portal cirrhosis, dilated veins rarely assume a radial arrangement at the umbilicus the so called *caput medusae* (Intra abdominal hemorrhage may result in discoloration of the

Fig 8 Prominence of upper abdomen as result of amyloidosis of liver and spleen as indicated upon skin (Ory and Jones Am Pract & Digest Treat 1 504 1950)

umbilical area due to blood pigment which reaches it via the lymphatics in the medial umbilical ligament)

In disturbances of the hormonal balance of the pituitary adrenal and sex glands, the distribution of the *pubic hair* may assume the pattern characteristic of the opposite sex (see Chapter 4)

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bulge and the lateral wall slopes toward the midline as toward a ridge pole When abdominal fluid (ascites) is present the weight of the fluid causes bulging in the flanks (unless the abdominal muscles are in excellent tone) resulting in a more flattened anterior abdominal area than in the above circumstance If the abdominal wall is relaxed rolling the patient from side to side will demonstrate a

Fig 11 Midline abdominal hernia at site of operative scar

protuberance of the dependent side of the abdomen as the fluid shifts to the side (Fig 21) In addition if the patient sits up or stands with shifting fluid bulging of the lower abdomen may be demonstrated (Fig 4) This change in the site of maximum distention does not apply to gaseous distention As a result of marked intra abdominal tension the umbilicus may project above the surface (Fig 5)

Localized Distention With enlargement of an organ the presence of a tumor with a localized collection of fluid or with localized dis

scaphoid one only as it appears in its extreme in the emaciation of starvation or as a part of emaciation due to malignancy chronic infection, and the like (Figs 24, 25, 27, pages 78 80)

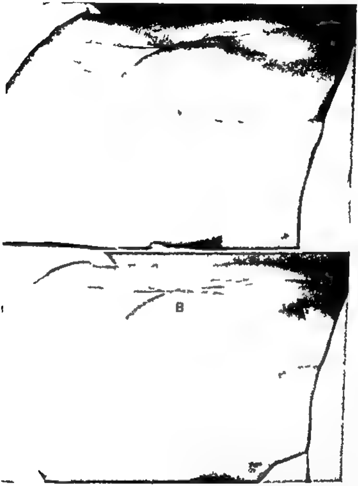

Fig 10 Peristaltic waves of stomach beginning in left abdomen moving to right A and A^1 to end at B site of duodenal obstruction due to carcinoma of ampulla of Vater

Abdominal distention may be localized or generalized Distention may be due to gas in the intestine to fluid in the abdominal cavity, or to tumor (Figs 3–6)

In *general distention* of the abdomen, it is protuberant at times to a remarkable degree The contour in gaseous distention may be different from that due to fluid If it is due to gas, the flanks do not

bowel or of the early stages of peritonitis In these diseases, the loops of bowel are very likely to be distended by gas This distention is quite obvious in the peristaltic pattern, in contrast to the smaller wave seen in normal peristalsis visible through a remarkably thin abdominal wall Peristalsis, if quiescent, may often be stimulated by snapping

Fig 13 Congenital weakness permitting bilateral inguinal hernias Note hernial ring at umbilicus

one's finger against the patient's abdominal wall several times or by flipping a towel against the abdomen The site of bowel obstruction can be determined roughly at times by noting the progression of the movements for a time which disappear in a certain area which is always quiet The appearance of gastric waves set up in pyloric obstruction may be dramatic The examiner may see consecutive large waves arising from beneath the left costal margin advance to the midline to the site of the pylorus to disappear at this point (Fig 10)

tended loops of bowel, abdominal distention may be sharply localized Thus the enlarged spleen may be recognized by its anatomic contour as a localized tumefaction of the left abdomen (Fig 7, also Fig 14 page 259)

A fulness of the right side likewise may delimit hepatomegaly (Fig 8) The large ovarian cyst may show a localized asymmetrical fulness in one or the other lower quadrant The irregular tumefaction of uterine fibromyomas is characteristic in the lower abdomen A large hypernephroma or polycystic kidney may fill one or the other

Fig 12 Hernia of abdominal wall as result of congenital absence of musculature

side of the abdomen with remarkable asymmetry The dilated gall bladder the pointing liver abscess the hepatic gumma, and gastric carcinoma as well as many other localized lesions may be of such size as to change the abdominal contour and to signalize underlying disease (Fig 9)

Peristaltic Movement The writhing movement of peristalsis in the loops of bowel usually cannot be visualized in the normal person though they may be seen at times in persons not suffering from intra abdominal disease Thus the emaciated person or the thin woman having had many children may have such a thin wall that peristaltic movements can be seen More often, such movements are indicative of obstruction, partial or complete, somewhere in the course of the

Fig 15 Femoral hernia indicated by arrow

Fig. 16 Direct inguinal hernia (left side)

Abdominal Wall In addition to the contour of the abdomen inspection is directed to the abdominal wall itself This is more revealing in the flat or scaphoid abdomen than in the protuberant abdomen

Diastasis Recti In the thin person, diastasis recti, separation of the rectus abdominalis in midline, may be easily noted The separa

Fig 14 (Same as Fig 13) Increased intra abdominal pressure following repair of inguinal hernias caused development of umbilical hernia

tion may be made more definite by tautening the muscles, as occurs if the patient lying supine, raises his head off the pillow Diastasis is seen most commonly in slender women who have borne children and in some patients who have had long standing ascites

Hernias These constitute another abnormality of the abdominal wall Hernias appear in certain areas as the result of inherent weakness or because a structure or region may be subject to undue stress (Figs 11, 12) A hernia arising from the abdominal cavity represents the protrusion of a loop of gut or other tissue through an abnormal hiatus always preceded of course by a peritoneal sac There are several characteristic sites The hernia may be seen as a localized tumor of variable size If it is large actual peristalsis of the gut within the hernial sac may be seen The tumor may disappear under observa

lies on his back Upon coughing or straining a bulge can be seen at the site of the internal ring as the sac pushes through the ring into the canal

PALPATION

As was pointed out in the preceding chapter, palpation is used first to explore the abdomen generally with only moderate pressure examining the area of anticipated disease last

Muscular Resistance In disease one of the first things to be noted may be increased tone of the abdominal musculature or actual spasm which is a reflex protective mechanism due to underlying disease The muscular resistance may be so slight as to be barely perceptible or at the opposite extreme be of boardlike rigidity as may be found in acute peritonitis or with a ruptured viscus Muscular resistance of the abdominal wall may be general as in generalized or diffuse peritonitis It may be localized if the peritonitis is local, right lower quadrant rigidity due to acute appendicitis is the most common example If the resistance is unilateral it is often evident in carrying out the following maneuver By applying equal pressure with one hand on each side of the midline of the patient s abdomen the examiner can readily appreciate the difference in tenseness

Tenderness Tenderness will be noted at the same time as the muscular resistance either by the patient s subjective complaint or better yet by watching the patient s facial expression This will portray pain the patient winces as a tender spot is palpated To eliminate the effect of apprehension malingering or psychoneurosis in this phase of the examination it is wise to divert the patient s attention by engaging him in an unrelated conversation and then observe the facial expression If he now laughs or talks unconcernedly when the former tender spot is reexamined it makes the previous apparent tenderness *questionable*

Rebound tenderness may be encountered over a subacutely inflamed structure and is seen best in appendicitis As palpating pressure is directed over the appendix at McBurney s *point* (the central point on an imaginary line drawn from the anterior superior spine to the umbilicus) little tenderness is noted However if the palpating fingers are suddenly *withdrawn* permitting the abdominal wall to bound back momentary pain or tenderness *is* apparent

tion as the patient lies down, to reappear with coughing straining or in reassuming the erect position (Palpation is important in amplifying inspection and will be discussed below)

The *epigastric hernia* is in the midline, penetrating the linea alba above the navel and often containing omentum rather than intestine An *umbilical hernia* is common, owing to weakness at the site of the former exit of the umbilical vessels, which therefore presents a likely site for a hernial sac, containing a loop of gut or a mass of omentum

Fig 17 Indirect inguinal hernia (right side) extending into scrotum

(Figs 13, 14) A herniation into the femoral canal the *femoral hernia* presents as a tumor at about the midpoint of Poupart s ligament (Fig 15) It occurs more commonly in women than men The most common hernia of all is the *inguinal hernia* almost always appearing in men The *direct inguinal hernia* penetrates the abdominal wall at the internal ring and appears as a tumor of variable size medial to the site of the deep epigastric artery (Fig 16) The *indirect inguinal hernia* enters the internal ring and later moves down the canal to protrude through the external ring into the scrotum (Fig 17) Early this can be diagnosed best by inspection as the patient

fingers The consistency of the organ is also important Even though the liver edge is not uniformly palpable the same characteristics should be noted of any nodules or irregularities in its edge (Fig 18) Systolic pulsation of the liver may be found in the rare instances of rheumatic tricuspid valve insufficiency

Where the spleen is palpable consistency is important in the differentiation of the soft acute splenic tumor from the firm solid infil

Fig 18 Gummatous hepatitis Ou line indicates palpable irregularity of liver edge due to large gummas Splenomegaly is also indicated

tration of myelogenous leukemia or of the congestive splenomegaly of so called Banti s disease or of the ague cake spleen of chronic malaria The size should be noted as well as the recognition of the notch for identifying purposes and the presence or absence of nodules (Figs 7 8 18)

Liver or Spleen The palpation of liver or spleen in the abdomen distended by fluid is difficult and if there is much fluid may be impossible by the ordinary method In such an event *ballottement* may be employed The technic consists in holding the fingers together and extended in a straight line with the forearm the whole producing

Deep Palpation After the general survey, palpation is carried deeper, as was described in Chapter 14 This is indicated in a search for more deeply lying disease and in palpating for tumors or other abnormalities Whereas moderate palpation may have caused no muscle spasm or tenderness, upon deep pressure the muscle may go into localized spasm, and there may be tenderness in the presence of underlying disease The same thing is true upon palpation of a tender liver edge, spleen, gallbladder, or either kidney

Upon deep palpation, one may be searching for tumors or infiltrations of neoplastic or inflammatory origin If such are felt, several points should be noted These are (1) size, (2) consistency, (3) tenderness (4) position, (5) attachment to underlying or overlying tissue, (6) attachment to one of the viscera, (7) movement with respiration, and (8) pulsation

The recognition of *size* is quite obvious The *consistency* upon examination is important in the diagnosis of cancers and lymphomas which are more likely to be firm or hard However, the same may be true of distended cysts Inflammations softening tumors, and some cysts may be fluctuant *Tenderness* on palpation will be obvious The *anatomic relationships* are often essential in diagnosis The *attachment* to adjacent structures or the attachment of the tumor to an organ is also of greatest importance in the clinician s attempt to decide upon the point of origin of the tumor and thus its identity Furthermore the *movement* or lack of movement of the tumor with respiration is of value If it moves, it may be attached to the liver or spleen which in themselves are freely movable Tumors unrelated to the solid organs also may move upon respiration as does carcinoma of the pylorus, for example Immobility of a tumor suggests an origin other than a solid organ and most certainly indicates fixation to the retroperitoneal structures *Pulsation* if expansile between the fingers or hands which attempt to enclose it, indicates a vascular tumor such as an aneurysm If pulsation is in one direction only and not expansile it is probably transmitted to the tumor from an adjacent large vessel, such as the aorta or other one

Palpation of Organs If the liver is palpable, the examiner should note whether the whole border is palpable indicating diffuse enlargement, and whether it is tender as the edge slips over the palpating

The contracted or spastic colon may be felt like a tender rope in its expected anatomic position Its segments can be rolled under the examining fingers The palpating hands may note the movements of peristalsis of the stomach small bowel or colon In obstruction dilated loops of gut may be recognized and the splash of fluid within the dilated loop may be felt

Hernias The palpation of hernial tumefactions is of help in making a diagnosis These tumors are usually soft and pliable because the content of the hernial sac is usually a loop of gut Often the sac may be reduced that is the sac and its contents may be pushed back through the ring into the abdominal cavity Furthermore the ring may be occluded by the palpating finger and upon asking the patient to cough an impulse is felt as the peritoneal sac with its contents is forced against the finger In the application of the method of palpating through the scrotum for the external ring of the inguinal canal as described in the last chapter the palpating finger will find in the presence of an indirect inguinal hernia a dilated ring Furthermore the borders of the ring are not as sharply outlined if the dilatation is great and the finger may be passed well into the canal In the act of coughing the impulse of the descending sac is evident

In epigastric hernia especially and at times in instances of umbilical hernia the sac is not reducible since the content is not a loop of gut but a tag of omentum This may become fixed in the sac owing to inflammation (This also occurs at times in the case of an intestinal loop)

Symptoms referred to the epigastrium may lead to the finding of a midline hernia (This is often not visible especially if the patient is moderately obese) The hernial sac lies between the parietal peritoneum and transversalis fascia Such a *properitoneal hernia* is felt as a tumor in the midline somewhere between the umbilicus and tip of the sternum The ring of such a hernia is usually so small that it admits only the tip of a finger Therefore palpation of the area with the palmar aspect of the hand in the usual manner commonly fails to demonstrate tenderness Only palpation of the midline with a finger tip may locate the point of tenderness and the hernia or its ring

Fluid Wave The demonstration of a fluid wave requires a special maneuver used in the presence of free fluid in the peritoneal cavity

a stiff implement The finger tips are then placed perpendicularly on the abdominal wall and suddenly jabbed in toward the site of the expected border of liver or spleen This quick movement displaces the fluid momentarily, permitting the fingers to reach and to identify the margin of the solid organ or tumor (Fig 19)

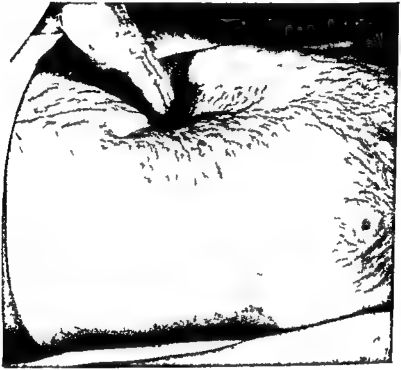

Fig 19 Technic of ballottement in abdomen containing fluid

Kidneys The kidneys are examined for an estimation of their size Tenderness is likely to be encountered in inflammatory diseases or in the presence of infections The student may well imagine the physical characteristics upon examination of the large hard mass of hypernephroma or the coarsely nodular enlarged kidney of polycystic disease The congenitally movable (floating) kidney is remarkable in that it can be grasped between the hands, front and back and be held there, preventing its ascent on expiration The horseshoe kidney is felt as a mass of firm consistency, in size suggesting the palm of the hand, and lying across the midline below the level of the umbilicus and over the promontory of the sacrum

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Hernias The palpation of hernial tumefactions is of help in making a diagnosis These tumors are usually soft and pliable because the content of the hernial sac is usually a loop of gut Often, the sac may be reduced that is the sac and its contents may be pushed back through the ring into the abdominal cavity Furthermore, the ring may be occluded by the palpating finger and upon asking the patient to cough an impulse is felt as the peritoneal sac with its contents is forced against the finger In the application of the method of palpating through the scrotum for the external ring of the inguinal canal as described in the last chapter the palpating finger will find in the presence of an indirect inguinal hernia a dilated ring Furthermore the borders of the ring are not as sharply outlined if the dilatation is great and the finger may be passed well into the canal In the act of coughing the impulse of the descending sac is evident

In epigastric hernia especially and at times in instances of umbilical hernia the sac is not reducible since the content is not a loop of gut but a tag of omentum This may become fixed in the sac owing to inflammation (This also occurs at times in the case of an intestinal loop)

Symptoms referred to the epigastrium may lead to the finding of a midline hernia (This is often not visible especially if the patient is moderately obese) The hernial sac lies between the parietal peritoneum and transversalis fascia Such a *properitoneal hernia* is felt as a tumor in the midline somewhere between the umbilicus and tip of the sternum The ring of such a hernia is usually so small that it admits only the tip of a finger Therefore palpation of the area with the palmar aspect of the hand in the usual manner commonly fails to demonstrate tenderness Only palpation of the midline with a finger tip may locate the point of tenderness and the hernia or its ring

Fluid Wave The demonstration of a fluid wave requires a special maneuver used in the presence of free fluid in the peritoneal cavity

The patient assumes the recumbent position. The examiner places the palm of the hand with fingers extended on one side of the abdomen, and taps the opposite side of the distended abdomen with the finger tips of the other hand If a moderate amount of fluid is present a definite impulse is transmitted to the passive hand A very fat abdominal wall may give a similar finding To eliminate transmission

Fig 20. Demonstration of ascites Assistant exerts pressure in midline left hand is applied to flank right is poised to deliver quick tap to opposite side

of the wave by the fat or to accentuate an indefinite wave an assistant may put pressure on the midline of the abdomen by using the ulnar border of one of his hands (Fig 20)

Percussion

Distention The most obvious application of this technic to the abdomen in disease is to determine the cause of the abdominal disten

tion noted at the first glance If it is due to gas, generally all areas of the abdomen will emit a tympanitic note

If the distension is due to free fluid in the recumbent position there will be dulness in the flanks that is at the sides, since fluid seeks a level The front of the abdomen is tympanitic upon percussion since the air containing bowel—if free to do so—will float on the surface

Fig 21 Shifting of free fluid in peritoneal cavity (case of portal cirrhosis) Solid line indicates level of dulness in flank in recumbency broken line in left lateral decubitus (Note bulging of flank on dependent side)

of the fluid A simple maneuver may aid in determining if the fluid is free The percussed height of dulness due to fluid is indicated by a skin pencil in the recumbent position The the patient turns on his side After a few moments percussion reveals if the fluid is free a higher dull level on the lowermost side At the same time the bowel floats to the uppermost side or flank and now the note is tympanitic where it was dull before By reversing the sides the shift is again demonstrable This is termed *shifting dulness* (Fig 21) If the patient sits or stands the shifting dulness is to the lower abdomen with a tympanitic note above the fluid level

If fluid is walled off or loculated on one side or in one quadrant of the abdomen the shift is not demonstrable An excellent but now rare example of this is the huge ovarian cyst Here the signs of fluid may be anterior in the distended abdomen, with tympany being present in the flanks and back These are the findings by virtue of the fact that the bowel is displaced backward and laterally, away from the anterior wall by the great amount of encapsulated fluid

Solid Organs As was indicated in the preceding chapter, percussion is readily applied to solid organs to determine their size, as a check upon palpation or instead of it (Palpation is often unsuccessful in a tense, distended abdomen)

Liver Percussion may therefore be of aid in mapping out the borders of the enlarged liver, as well as its contour The beginner must remember that this applies not only to its inferior border but also to the upper border In other words, in estimating liver size it is necessary to percuss the lower border of pulmonary resonance in the back, in the axilla and anteriorly to recognize any upward enlargement of liver as it encroaches upon the chest cavity Conversely the atrophic liver may be recognized by a decrease of normal liver dulness

Spleen Just as the diseased liver may be mapped out by percussion, so too the technic may be applied to splenomegaly Contour as well as size may be mapped out with the aid of percussion, outlining it with the skin pencil if necessary

Tumor Masses Percussion aids in confirming the visualization and palpation of tumor masses which displace tympanitic hollow viscera (Thus dulness may be noted over epigastric tumors over hypernephromas, polycystic kidneys ovarian tumors and cysts and tumors of the uterus Normally the areas occupied by these tumors emit a tympanitic note upon percussion because portions of the stomach or bowel fill these regions)

Hollow Viscera The evaluation of percussion over the hollow viscera is attended by greater difficulty because the note is markedly tympanitic Nevertheless a hugely dilated tense, tympanitic stomach may establish a diagnosis of pyloric obstruction confirming an impression gained in the history taking Likewise repeated demonstra

tion of tympany over one segment of the colon may suggest an ob structing lesion distal (caudal) to the site of the distended loop

In pneumoperitoneum the abnormal distribution of tympany is of paramount importance Following perforation of a peptic ulcer, air escapes from the duodenal or gastric perforation and produces a diffusely tympanitic note This may obliterate liver dulness partially or completely a point of great diagnostic significance This can be brought out or be made more clearcut by propping the patient up toward a sitting position The air rising upward to the diaphragm definitely reduces or completely masks hepatic dulness

Auscultation

There may be more point to the use of the stethoscope in disease than in examination of the abdomen in the healthy person

In the normal person one hears more or less continuous sounds of intestinal activity In disease these may be increased or decreased In enteritis with accompanying increased peristalsis the great activity is manifest by constant sounds associated with the peristaltic rushes Bleeding from a peptic ulcer or esophageal varices stimulates intestinal activity as does food in contrast to intraperitoneal bleeding which causes decreased sounds Partial obstruction in the intestinal tract is the cause of increased and at times loud sounds as hyperperistalsis attempts to pass the bowel content past the obstruction In mechanical obstruction distended segments of bowel containing fluid and air, provide resonating circumstances similar to those described in hydro pneumothorax the intestinal sounds having a metallic tinkling character

The absence of peristaltic movement is an important auscultatory sign of peritoneal irritation *particularly that due to* acute peritonitis it is as silent as the grave —an apt comment by the surgeon J B Murphy The paralytic ileus which develops in acute peritoneal dis ease accounts *for the absence* of sounds Lesser degrees of ileus are associated with diminished peristaltic sounds and may accompany a variety of abdominal conditions After abdominal operations there is often diminution of sounds for a day or so

Just as a friction rub is heard in pleural or pericardial disease so also may one elicit at times a peritoneal *friction rub* This may be

found over the spleen or liver In the former, it accompanies infarction because of the film of fibrin which is deposited on the splenic surface over the infarcted area Such a friction rub will usually be heard over the lower costal region (left hypochondrium) in the region of the anterior axillary line More rarely, it may appear over tumors of the splenic pulp when the peritoneal surface is involved Over the site of localized hepatic disease, as in liver abscess, or in tumors of

Fig 22 Fulness in right flank because of large renal cyst which developed following crushing injury to abdomen (From author's medical service Louisiana State University School of Medicine and Charity Hospital New Orleans)

the liver a friction rub may be heard at times These are usually also heard over the lower costal regions on the right side Deep respiratory movements may accentuate or bring out the friction rub

By auscultation a *bruit* may be heard over tumors of vascular origin—aneurysms of the abdominal aorta or other large vessel Occasionally, a *venous hum* may be found in the epigastrium in persons having portal cirrhosis with a well developed collateral venous circulation

The Abdominal Reflex

The abdominal reflex may be lost in diseases affecting the pyramidal tracts Its loss may be the earliest sign of progressive disease of the pyramidal system in either the brain or spinal cord This reflex therefore will be missing on the affected side in hemiplegia Its disappearance may occur very early in multiple sclerosis it is absent also in any transverse lesions of the spinal cord in the cervical or upper dorsal segments (page 38)

The Back

In the previous chapter it was emphasized that examination of this area may be important even though it only occasionally yields abnormal physical findings In certain diseases of the kidney it may offer the only clearcut physical signs

Inspection A change of the usual concave curvatures is the abnormality looked for The usual alteration in the normal curve will be that of fulness or actual bulging changing the concave line to a straight one or in more marked disease, to a convexity Kidney disease especially tumor or infection of the perirenal tissue is the most usual type of disease to wipe out the normal curve (Fig 22) Retroperitoneal sarcoma or other tumor aneurysm of the abdominal aorta or hemorrhage into the retroperitoneal tissues may do the same Aneurysm of the abdominal aorta will cause fulness on the left side and is usually accompanied by pulsation if inspection is carried out in a good light Occasionally the retrocolic growth of carcinoma of the colon may cause bulging Hepatomegaly and subdiaphragmatic abscess may be of such size as to cause obvious fulness in the region of the floating ribs and flank (The changes attendant upon scoliosis of the spine will be considered in Chapter 19)

As was noted in the previous chapters pulsation of the dilated intercostal arteries as part of the collateral arterial circulation due to coarctation of the aorta may be observed in the back of the chest Some of this pattern may be visible in the back below the level of the thorax At times the collateral venous circulation due to the presence of portal cirrhosis is most prominent in the back Other causes for a venous collateral circulation may be encountered more rarely (Figs 23 24)

Palpation Palpation in the presence of perirenal or renal disease even without visual signs, may reveal tenderness on deep pressure With fulness or bulging especially if on an inflammatory basis tenderness is usual Muscle resistance or splinting accompanies this Pulsation may be felt if aneurysm of the abdominal aorta is present

Fig 23 Collateral venous circulation on back because of hypernephroma with metastasis to liver and invasion of portal vein (see Fig 1)

Percussion As an unusual finding dull tympany may be elicited over the back under certain circumstances The tympany is not clear and ringing because of the thick wall If for any reason the bowel is displaced backward by a large tumor (an ovarian cyst is the best example), tympany will be found in the flanks and back At times, the tympany may be more localized For example, I have seen loculated fluid due to plastic tuberculous peritonitis push loops of bowel posteriorly to produce tympany I have also found tympany in the left back due to pneumoperitoneum of the lesser peritoneal sac accompanying a perforated gastric ulcer

Fist percussion may reveal tenderness over the renal area especially n the presence of a large stone when ordinary palpation does not The stone may need to be jarred in order to produce pain

Fig 24 (Same as Fig 23) Collateral venous circulation shown by infra red photography

Diseases with Major Signs Related to the Abdomen

Just as in the chapters on disease of the chest and heart, reviews of the physical findings in certain diseases of the abdomen and its contents are appended The purpose is to indicate to the student how the several methods of examination collect evidence which may be helpful in diagnosis As has been emphasized several times previously the history of symptoms more often than the physical findings leads to the steps taken to establish the diagnosis in abdominal disease

DISEASES OF THE PERITONEUM

ACUTE PERITONITIS (GENERALIZED)

Definition An acute inflammation most commonly due to a ruptured viscus, accompanied by severe constitutional reactions and frequently ending fatally, especially if not treated

Pathology The peritoneum is red and lusterless with fibrinous exudate on the surface, and is accompanied by a purulent effusion

Physical Signs *Inspection* Abdominal distention, respiration of the costal type *Palpation* Marked tenderness and muscular rigidity *Percussion* In general, tympany because of distended bowel, dulness in flanks if much free fluid *Auscultation* Because of paralytic ileus, the silent abdomen,' no borborygmi being heard

Remarks The facies are the anxious, pinched ones of the so called hippocratic facies'

TUBERCULOUS PERITONITIS

Definition A chronic inflammation due to the tubercle bacillus, originating from ulceration of a tuberculous focus into the free peritoneal cavity or being of hematogenous origin

Pathology The peritoneum is studded with many miliary tubercles, there is accompanying fluid or plastic exudate the latter between loops of gut may wall off the process to localized areas

Physical Signs *Inspection* A distended abdomen suggesting fluid through bulging of the flanks, if localized, asymmetrical prominence due to fluid accumulated in one region *Palpation* Slight to moderate tenderness little muscle reaction to palpation accounting for the so called 'doughy feel , fluid wave if fluid is free, fluid localized in one area by plastic exudate may be so tense as to suggest a localized tumor *Percussion* In free fluid, tympany over the front of the abdomen, dulness in the flanks, shifting dulness, with localized fluid, dulness in the area modified at times by the tympany of the dilated loops of gut walling off the loculated fluid

CARCINOMATOSIS OF THE PERITONEUM

Definition A generalized involvement of the peritoneum by carcinomatous growth originating in one of the abdominal organs

Pathology The peritoneum is studded with tumors varying in size from miliary size to ones several centimeters in size Usually, serosanguineous fluid is free in the peritoneal cavity

Physical Signs *Inspection* A distended abdomen with the suggestion of free fluid *Palpation* Generalized tenderness, but little muscle reaction the mass of the primary growth may be found as a localized tumor with emaciation and thinning of the abdominal wall the metastatic nodules on the peritoneum may be palpable *Percussion* With free fluid tympany over the front dulness in the flanks and shifting dulness

Remarks *Emaciation is common in these patients*

Pneumoperitoneum

Definition The accumulation of free air in the peritoneum following perforation of a viscus It is found most often following perforation of a peptic ulcer

Pathology There is merely the pathology of the original lesion *the site of perforation If untreated* acute peritonitis follows very frequently

Physical Signs *Inspection* Costal respiration only *Palpation* Tenderness and muscle guarding because of peritoneal irritation *Percussion* Tympany most notable in its *obliteration of liver dulness* as air is interposed between the abdominal wall and the liver and accumulates under the diaphragm especially demonstrable by elevating the head of the patient s bed

DISEASES OF STOMACH AND BOWEL

Gastric Carcinoma or Ulcer

Definition Benign or malignant ulcer most often of the prepyloric region often leading to symptoms of obstruction

Pathology *Carcinoma presents a tumor of the affected area* often accompanied by gastric dilatation because of *obstruction Metastasis* to the liver or peritoneum may be present Benign ulcer may have little infiltration a mass of cicatrix and peritoneal inflammation may present an obstructing *mass with* gastric dilatation

Physical Signs *Inspection* In the flat or scaphoid abdomen a mass may be visible in the epigastrium or to the left of midline which

may or may not move with respiration, the gastric dilatation may cause localized bulging in the left upper abdomen, gastric peristaltic waves may be prominent in obstruction *Palpation* From a firm to hard, often irregular, tender mass may be felt, either fixed or mobile on respiration, in the event of cancer, nodules in an enlarged liver may indicate a metastasizing lesion, rarely an enlarged lymph node is found above the left clavicle (metastatic in origin, *Virchow s node*) *Percussion* Tympany over the dilated stomach dulness over the mass

Remarks The rare syphilitic gumma of the stomach may produce the same clinical picture

Duodenal Ulcer

Definition A most common organic disease of the gastrointestinal tract, at times causing obstruction

Pathology A benign ulcer of the first portion of the duodenum which usually shows some thickening of the duodenal wall and evidence of peritoneal reaction Obstruction may develop through cicatrix

Physical Signs *Inspection* Negative unless an inflammatory mass is present to provide a tumefaction to the right of midline in the epigastrium *Palpation* Tenderness only over the duodenum a palpable mass usually fixed on respiration, if much scar and peritoneal reactions are present

Acute Appendicitis

Definition An acute inflammation of the appendix with a rather usual symptom complex at times, rupture

Pathology The appendiceal peritoneum is injected and often shows fibrinous exudate Rupture may lead to generalized peritonitis or may have been localized by peritoneal reaction and adhesions from former attacks

Physical Signs *Inspection* Respiratory movements of the abdomen usually limited to the upper portion *Palpation* Tenderness in the right lower quadrant with muscle guarding or resistance there may be rebound tenderness, if a localized peritonitis has occurred

with appendiceal rupture (appendiceal abscess), a fixed, tender mass may be present

Remarks An appendix placed retrocecally may be accompanied by little tenderness and muscle reaction anteriorly but may show these findings in the flank

Disease of Cecum

Definition Carcinoma or chronic inflammation due to tuberculosis or amebiasis producing a clinical picture often difficult of differentiation either by symptoms or signs

Pathology In any of these diseases, the wall of the cecum is infiltrated and ulceration is present

Physical Signs *Inspection* Fulness or visible tumor present in the right lower quadrant *Palpation* A tender firm or hard mass up to from 10 to 12 cm in diameter usually not movable *Percussion* Dulness or dull tympany

Carcinoma of Colon

Definition A neoplastic growth with symptoms due either to ulceration or to obstruction most common in the sigmoid colon

Pathology A malignant tumor may develop in any portion of the colon Ulceration of the tumor or obstruction of the colon may be present

Physical Signs *Inspection* A localized tumor or fulness of the abdomen may be obvious peristaltic waves increased if obstruction is present *Palpation* A tender firm or hard mass indicates the site of the tumor it may be movable early in involvement of the transverse colon *Percussion* Dulness or dull tympany over the tumor mass if obstructive tympany over the colon proximal to the mass *Auscultation* Increased activity heard due to obstruction

DISEASES OF THE LIVER

Acute Hepatitis

Definition An acute infection characterized by constitutional symptoms gastrointestinal symptoms and usually jaundice

Pathology There is usually diffuse enlargement of the liver

Physical Signs *Inspection* Commonly jaundice *Palpation* Liver edge palpable and tender, from one to several fingerbreadths below the costal margin, splenic tip palpable at times

PORTAL CIRRHOSIS

Definition A chronic liver disease due to malnutrition plus possibly certain toxic factors, characterized by chronic gastrointestinal and constitutional symptoms

Pathology Early, the liver is enlarged Later, following an overgrowth of connective tissue, the liver shrinks (the hobnail liver) with concomitant obstruction to the portal circulation causing the development of a collateral circulation and ultimately ascites

Physical Signs *Inspection* Usually slight icterus of the skin and scleras, development of spider angiomas over the face and chest, with portal obstruction dilated veins over the abdomen and chest, collateral circulation, and the abdominal distention due to fluid *Palpation* Early, probably enlargement of the liver the edge being palpable below the costal margin, first smooth and firm, later the edge becoming hard and nodular, with shrinkage, the liver edge becomes impalpable, a fluid wave, an enlarged firm spleen *Percussion* Early, a normal or increased area of liver dulness, with atrophy, a decreased area of liver dulness, at times absence of such, dulness in the flanks due to fluid, with shifting dulness

Remarks Dilated and bleeding hemorrhoidal vessels may make up part of the collateral circulation

METASTATIC HEPATIC CARCINOMA

Definition Multiple nodular involvement of the liver secondary to carcinoma of the stomach lung or other organ

Pathology The liver is usually large owing to the multiplicity of metastatic nodules

Physical Signs *Inspection* Often fulness and bulging of the right upper quadrant and epigastrium, in some abdominal distention due to ascites *Palpation* A large liver extending to or even below the level of the umbilicus with an irregular or nodular border and surface, fluid wave if ascites is present *Percussion* Increased area of liver dulness, shifting dulness in the flanks

Liver Abscess (Solitary)

Definition Usually a unilocular abscess due to *Endamoeba histolytica* accompanied by pain constitutional symptoms

Pathology Usually there is a solitary abscess more often in the right lobe of the liver and in its upper portion, it may invade the right lower lobe of the lung

Physical Signs *Inspection* Decreased abdominal respiratory movements, fulness or bulging of the right upper quadrant of the abdomen or of the right hypochondrium, if of the left lobe these findings are present in the epigastrium *Palpation* Liver edge usually palpable and tender below the right costal margin if of the left lobe a palpable mass in the epigastrium with at times a tumor on its surface *Percussion* Increased liver dulness the lung base abnormally high in one segment of the circumference of the right hemithorax generally with decreased or absent descent of the right diaphragm *Auscultation* Rarely a friction rub present over the pointing abscess

Remarks If the right lower pulmonary lobe is invaded, there may be signs of pneumonitis

Gummatous Hepatitis

Definition Solitary or multiple gummas of the liver occurring late in syphilitic infection The physical signs may simulate those of metastatic carcinoma or of the early stages of a solitary abscess

DISEASE OF THE GALLBLADDER

Cholecystitis

Definition Acute or chronic inflammation of the gallbladder at times accompanied by pain at times constitutional and usually gastrointestinal symptoms

Pathology There is inflammation and infiltration of the gall bladder wall The viscus is usually distended

Physical Signs *Inspection* In acute cases decreased abdominal respiratory movements rarely a tumefaction in the right upper quadrant *Palpation* Tenderness beneath the right costal border in the midclavicular line occasionally the distended bladder is palpable

DISEASES OF THE SPLEEN

ACUTE SPLENIC TUMOR

Definition Enlargement of the spleen in certain acute infections, most often in typhoid fever, infectious mononucleosis, and early malaria

Pathology The spleen is enlarged and soft

Physical Signs *Inspection* Negative *Palpation* Spleen commonly felt as a soft, tender edge, varying from just the tip at the height of inspection to enlargement several centimeters below the costal margin *Percussion* Frequently splenic dulness *Auscultation* A friction rub if an abscess forms with overlying perisplenitis

CHRONIC MALARIA

Definition With recurrent malaria progressive splenic enlargement

Pathology The spleen is enlarged, firm or hard and gray

Physical Signs *Inspection* In advanced instances, visible tumefaction in the left upper abdomen *Palpation* A firm or hard, nontender border, as low as the level of the umbilicus or lower, the notch often palpable *Percussion* Usually clearly defined splenic dulness

MYELOGENOUS LEUKEMIA

Definition A chronic white blood cell dyscrasia accompanied characteristically by splenomegaly and often hepatomegaly

Pathology The spleen is enlarged, and may be immense It keeps its shape and anatomic characteristics such as the notch Infarction is common

Physical Signs *Inspection* Fulness of the left abdomen delimiting the splenomegaly *Palpation* A firm hard organ outlined even down to the left lower quadrant, extending to the right side in some instances commonly with a palpable notch the liver edge often palpable below the right costal border *Percussion* Confirmation of the splenomegaly as palpated

CONGESTIVE SPLENOMEGALY (BANTI S DISEASE)

Definition A chronic disease thought to be due to increased pressure in the portal or splenic veins characterized by splenomegaly anemia, and leukopenia

Pathology An enlarged and hard spleen, cirrhosis of the liver in most cases

Physical Signs *Inspection* Pallor of the skin, fulness in the left upper abdomen and flank because of splenomegaly *Palpation* A hard spleen extending perhaps down to the level of the umbilicus *Percussion* Confirmatory of the splenomegaly

Remarks In the later stages the clinical picture of portal cirrhosis is established

DISEASES OF THE KIDNEY

In the so called medical diseases nephritis nephrosis and the like there are no local physical signs so far as the organs themselves are concerned Nevertheless in acute nephritis there may be tender ness upon palpation over the swollen kidney So called surgical diseases of the kidney pyelitis hydronephrosis tuberculosis and calculi may show associated tenderness only on palpation In some instances the kidney may be enlarged

Perirenal Abscess

Definition Inflammation about a kidney due to extension of infection into the perirenal tissue

Pathology Inflammation having progressed to suppuration

Physical Signs *Inspection* Fulness of the costovertebral angle area and loss of the normal concave curvatures *Palpation* Con firmation of inspection with demonstration of tenderness and spasm of the paravertebral muscles

Tumor of the Kidney

Definition The more common malignant renal tumors are the hypernephroma in adults and embryonal nephroma (Wilms tumor) in children

Physical Signs *Inspection* If sufficiently large fulness of the abdomen and flank on the affected side loss of the concave curva tures of the flank *Palpation* Confirmation of inspection and demonstration of a tumor mass in the kidney region *Percussion* Dulness over the tumor

DISEASES OF THE SPLEEN

Acute Splenic Tumor

Definition Enlargement of the spleen in certain acute infections, most often in typhoid fever, infectious mononucleosis, and early malaria

Pathology The spleen is enlarged and soft

Physical Signs *Inspection* Negative *Palpation* Spleen commonly felt as a soft, tender edge, varying from just the tip at the height of inspection to enlargement several centimeters below the costal margin *Percussion* Frequently splenic dulness *Auscultation* A friction rub if an abscess forms with overlying perisplenitis

Chronic Malaria

Definition With recurrent malaria, progressive splenic enlargement

Pathology The spleen is enlarged firm or hard and gray

Physical Signs *Inspection* In advanced instances, visible tumefaction in the left upper abdomen *Palpation* A firm or hard, nontender border, as low as the level of the umbilicus or lower the notch often palpable *Percussion* Usually clearly defined splenic dulness

Myelogenous Leukemia

Definition A chronic white blood cell dyscrasia accompanied characteristically by splenomegaly and often hepatomegaly

Pathology The spleen is enlarged and may be immense It keeps its shape and anatomic characteristics such as the notch Infarction is common

Physical Signs *Inspection* Fulness of the left abdomen delimiting the splenomegaly *Palpation* A firm hard organ outlined even down to the left lower quadrant, extending to the right side in some instances commonly with a palpable notch, the liver edge often palpable below the right costal border *Percussion* Confirmation of the splenomegaly as palpated

Congestive Splenomegaly (Banti's Disease)

Definition A chronic disease thought to be due to increased pressure in the portal or splenic veins, characterized by splenomegaly anemia, and leukopenia

16. THE GENITALIA, PERINEUM, ANUS, RECTUM—1

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

IN EXAMINATION OF the genitalia, inspection and palpation are the only two methods used Special methods of examination with instruments are used by the genitourinary surgeon and by the gynecologist to extend inspection farther into the genitourinary tract Some of these require special technical skill and others do not Thus the cystoscope is used to inspect the bladder and the urethroscope the urethra The use of the bivalve speculum for vaginal examination will be briefly mentioned though the student will become more familiar with its use in the gynecology clinic

The physical examination all too often stops short of the genital region because of a sense of delicacy on the part of the physician especially of the older ones and understandably so for the female patient but less so for the male Even in the female the routine physical examination should include examination of the genitalia under certain circumstances One often finds women of the older generation objecting to this examination With the educational articles appearing in women s magazines regarding cancer and the like, the younger women see the value of this somewhat embarrassing examination In general the routine physical examination of girls beyond puberty or in young women usually does not include examination of the anogenital area in the absence of complaints referable to these regions On the other hand every routine physical examination in

POLYCYSTIC DISEASE

Definition A replacement of kidney tissue, bilaterally, by great numbers of cysts of varying size

Pathology Kidneys several times the normal size, nodular owing to the many cysts

Physical Signs *Inspection* Fulness of the abdomen and flanks, loss of the usual concave contours in the flank *Palpation* Large, nodular masses in the kidney areas *Percussion* Dulness over the enlarged kidneys

Remarks Hypertension often accompanies the disease in the later stages

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The glans in the circumcised male is covered with a thicker and less sensitive epithelium than in one in whom it is protected by a prepuce In the presence of a prepuce especially if the subject is not cleanly and if the prepuce is tight smegma—a cheesy, ill smelling material—accumulates This is secretion from the sebaceous glands at the coronal sulcus Activity of secretion of these glands begins at the time of puberty

Normally the *urethral meatus* is at the tip of the glans, and varies somewhat in size from one person to another

Palpation of the penis adds nothing to the examination in the absence of disease

Scrotum and Contents The scrotum elongates with the onset of puberty and hangs lower than in the infantile state because of descent of the testicles (Examination carried out in a cold room causes the cremasteric muscles to contract and more or less reproduces the infantile state) There is asymmetry in that the scrotum on the left side hangs at a slightly lower level than on the right Upon inspection some information may be gained regarding the relative size of the testicles In the aged they obviously are smaller

Palpation is much more worth while than inspection in the examination of the scrotum and its contents The testicles are felt to be rubbery in consistency neither hard nor soft They are about 4 cm ($1\frac{5}{8}$ inches) in length in the long axis In middle age they begin to shrink somewhat in size and become softer in consistency By the time old age is reached they have become quite atrophic The *epididymis* is felt posteriorly (the caput lying above) to the testicle as a soft slightly tender structure and the *spermatic cord* may be followed up to the external inguinal ring Normally a distinctly unpleasant sensation is experienced when the testicle is squeezed The absence of *testicular pain* may be of significance in neurologic disease

Prostate Gland Examination of the prostate gland is carried out by digital palpation via the rectum The patient either lies on his side with knees drawn up or stands with feet apart bent over a chair the elbows on the seat of the chair knees being kept straight Another position preferred by some is that in which the patient supports himself on his elbows and knees The knee chest position may also be used (Fig 4 page 522) The lubricated gloved index finger is in

women beyond thirty years of age should include this examination If the mortality rate in uterine carcinoma is to be reduced, it will be only by early diagnosis, and this means the finding of suspicious lesions before symptoms appear

In this chapter, consideration will be given not only to the genitalia but also to the anus, rectum, and perineal region in general As a matter of convenience this area is examined at one time or exposure Furthermore, rectal examination may be necessary to complete the study of the genitourinary organs

The Male Genitalia

Here attention is directed to the penis, contents of the scrotum the prostate, and the seminal vesicles

Normally the *external genitalia* remain infantile until puberty (The years of puberty vary greatly as related to race and family) At this time the penis and testicles begin to grow The pubic hair appears to become more extensive with the passage of time, and it appears also on the scrotum and on the perineum As indicated in Chapter 14 the pattern of the pubic hair extends up from the pubic area as a triangle with the apex at the umbilicus The amount of hair varies from person to person, usually being more profuse in the brunet than in the blond In old age the hair becomes more sparse Pigmentation of some degree of the skin of the penis and scrotum develops at puberty

Penis The size of the penis in the mature male varies greatly between persons and even with race With the onset of middle age, some atrophy of the tissues of the penis begins and becomes marked in old age

Usually the prepuce is easily retractile to expose the glans In some men the foreskin is so tight it cannot be retracted or only with difficulty The contour of the glans penis is dependent upon this In the person with a freely retractile foreskin and in the circumcised, the glans is almost as broad as the distance from the corona to the urethral meatus In the male with a tight foreskin the glans develops with a more pointed or conical shape This shape is maintained even though circumcision is carried out later in life

The glans in the circumcised male is covered with a thicker and less sensitive epithelium than in one in whom it is protected by a prepuce In the presence of a prepuce especially if the subject is not cleanly and if the prepuce is tight smegma—a cheesy, ill smelling material—accumulates This is secretion from the sebaceous glands at the coronal sulcus Activity of secretion of these glands begins at the time of puberty

Normally the *urethral meatus* is at the tip of the glans and varies somewhat in size from one person to another

Palpation of the penis adds nothing to the examination in the absence of disease

Scrotum and Contents The scrotum elongates with the onset of puberty and hangs lower than in the infantile state because of descent of the testicles (Examination carried out in a cold room causes the cremasteric muscles to contract and more or less reproduces the infantile state) There is asymmetry in that the scrotum on the left side hangs at a slightly lower level than on the right Upon inspection some information may be gained regarding the relative size of the testicles In the aged they obviously are smaller

Palpation is much more worth while than inspection in the exam ination of the scrotum and its contents The testicles are felt to be rubbery in consistency neither hard nor soft They are about 4 cm ($1\frac{5}{8}$ inches) in length in the long axis In middle age they begin to shrink somewhat in size and become softer in consistency By the time old age is reached they have become quite atrophic The *epididymis* is felt posteriorly (the caput lying above) to the testicle as a soft slightly tender structure and the *spermatic cord* may be fol lowed up to the external inguinal ring Normally a distinctly un pleasant sensation is experienced when the testicle is squeezed The absence of *testicular pain* may be of significance in neurologic disease

Prostate Gland Examination of the prostate gland is carried out by digital palpation via the rectum The patient either lies on his side with knees drawn up or stands with feet apart bent over a chair the elbows on the seat of the chair knees being kept straight Another position preferred by some is that in which the patient supports him self on his elbows and knees The knee chest position may also be used (Fig 4 page 522) The lubricated gloved index finger is in

serted its full length into the rectum. The prostate is felt anteriorly by the palmar aspect of the digital phalanx of the finger. The gland is felt to be firm, the lobes being of equal size with a median sulcus. The *seminal vesicles* may be reached if the examiner has a long index finger. They lie slightly laterally and above the prostatic lobes and are soft and give a sense of being cystic.

Fig 1 Demonstration of cremasteric reflex. Note elevation of right side of scrotum as skin of thigh is stroked.

Cremasteric Reflex. This is obtained by lightly stroking the inner aspect of the thigh with a dull instrument. The result is a contraction of the cremasteric muscle which elevates the testicle on that side (Fig 1). The presence of the reflex indicates an intact arc mediated through a center in the upper lumbar segments (D12, L1) (page 38).

The Female Genitalia

Here again examination consists of inspection and palpation Examination is usually carried out in the lithotomy position In this position the patient lies upon her back knees drawn up and thighs spread well apart (This position can be best maintained by having the table equipped with foot rests) At times it is advantageous to use a lateral position with the knees drawn up (Figs 2 3)

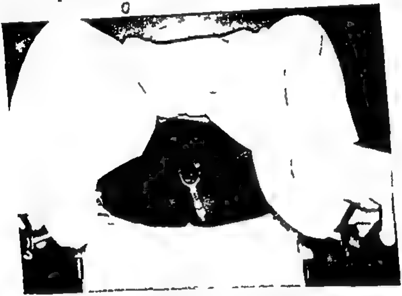

Fig 2 Lithotomy position Bivalve vaginal speculum is in place for inspection of vagina and uterine cervix

Inspection of the *external genitalia* includes a note concerning the hair distribution over the pubic area the labia majora and perineum The texture of the skin and its appearance on the labia majora and in the crease between the labia and inner aspect of the thigh should be observed

In the normal subject hair on the *mons veneris* and on the labia majora begins to appear with puberty In its full growth it covers the mons with its upper border in a straight line at slightly above the level of the upper border of the pubic bones The labia majora are also covered by hair As in the male the amount of hair depends on

the type of person, being more luxuriant in the brunette than the blonde With the appearance of middle age and progression into old age, the hair becomes more sparse Pigmentation of the skin of the labia majora and the perineum generally develops at puberty During normal pregnancy, this pigmentation increases, and the labia may become very dark

Vulva The subject being in the lithotomy position, in the infantile and virginal state the labia majora are usually in apposition, the labia

Fig 3 Sims's position Patient is on her side knees drawn up the upper higher than other (Convenient position for examination of perineum and anus)

minora often not being visible (Fig 35 page 616) The *labia majora* are full and rounded The vulva of the married woman may show certain changes The labia majora become somewhat separated, the labia minora now become visible and may protrude from between the labia majora and even a portion of the *vaginal introitus* may become apparent

In the woman who has had children, these changes become more obvious The labia majora appear less full and are separated With the approach of menopause and progressing thereafter, the labia majora lose their full contour become flattened and well separated

to expose the vaginal opening the urethra and clitoris (Fig 36, page 616)

Palpation confirms these changes noted upon inspection Early in life, the labia majora are firm and full later in life the flabbiness accompanying progressive atrophy, especially in the years following the menopause is readily demonstrated by the palpating fingers

Inspection of the vulva is continued after the gloved fingers separate the labia majora. The clitoris and its prepuce the labia minora, the urethral meatus and the vaginal orifice or its obstructing hymen or hymenal remains are inspected These structures normally are pink The openings of Bartholin s and Skene s glands are searched for In the uncleanly there is often some cheesy white material lying along the clitoris and in the crevice between the labium majus and labium minus This is smegma secretion from the sebaceous glands (Fig 42 page 620)

Normally the prepuce over the glans of the *clitoris* is movable In the virgin the *labia minora* are thin and relatively narrow With the establishment and continuation of sexual intercourse the labia minora become thicker and elongated

In the virginal woman the *hymen* is a membrane of variable thickness closing the vaginal orifice except for an opening usually not admitting the tip of the index finger Following destruction of the hymen its remains may be seen at the *vaginal introitus* as a series of small projections (carunculae hymenales) These usually disappear after some years especially if pregnancy has occurred

The *vaginal orifice* though available for inspection in the younger woman only upon separation of the labia, later in life becomes gaping, and may be seen even without manually spreading the labia

Vagina and Cervix The cervix of the uterus and the vagina are inspected with the aid of the bivalve vaginal speculum (Fig 2) This lubricated instrument is passed into the vagina the leaves of the speculum are then separated to bring the *cervix* into view The cervical os normally may be seen as a small round opening The *vaginal wall* is viewed as it falls together with the slow withdrawal of the instrument its leaves being separated slightly (The instrument must not be used in the virgin except in unusual circumstances) Normally the lining of the vagina and the epithelium covering the

cervix should be pink The covering of the cervix is smooth, the vaginal lining lies in folds, and the walls fall together as the speculum is withdrawn A small amount of mucoid material is seen not uncommonly at the cervical os

Fig 4 Bimanual pelvic examination Pelvic organs may be felt between left second and third fingers in vagina and right hand making pressure upon abdominal wall

Though palpation adds little to the inspection of the vulva in the normal woman it is useful in obtaining information concerning the uterus tubes, and ovaries

For the *bimanual vaginal* examination the bladder should be emptied to permit adequate palpation The gloved lubricated second and third fingers of the left hand are gently passed up as far as

possible into the vagina The right hand is placed upon the abdomen immediately above the pubic bone (Fig 4) This hand presses the uterus and adnexa downward toward the finger tips placed in the vaginal vault Thus in thin or spare women and less satisfactorily in obese women the examiner may feel through the vaginal vault the ovaries as small firm masses the tubes may be rolled between the fingers of the two hands and the size mobility, and contour of the *uterus* may be ascertained The cervix uteri is a firm structure (Bimanual palpation must not be attempted in the virgin Digital examination by rectum may provide a source of information in such instances)

Pregnancy The changes occurring in the external genitalia are on a normal physiologic basis and therefore should be considered in this chapter

Inspection will show increased *pigmentation* of the whole perineal region The labia both majora and minora are more engorged or swollen at least partially as the result of impairment of the venous return by the pressure of the gravid uterus on the femoral and iliac veins For the same reasons the veins of the labia minora and the inner aspect of the labia majora become dilated The mucous membrane of the labia minora and of the vagina are bluish red because of congestion rather than the pink color of the nonpregnant woman This is well seen upon examination of the vagina by use of the speculum The cervix uteri is also purplish instead of pink Palpation demonstrates a softened cervix

The Anus and Rectum

In both sexes the perineum and anal regions should be examined at least if the history suggests disease *in* the young and always as part of the routine examination in those approaching middle age and beyond Untold numbers of rectal carcinomas have remained undiagnosed in the early stage merely for the lack of a digital examination by a lazy physician or because of the modesty of a woman the complaint of anal bleeding being passed off as hemorrhoids The importance of this examination in the differential diagnosis of carcinoma of the rectum and hemorrhoids was recognized by Master John of

Arderne when he said in about 1390, 'And thus shall ye recognize it Ye shall put thy finger in the rectum'

Inspection must include the skin of the perineum and the folds and wrinkles of the anus In the absence of disease, no comment is necessary except to call attention to the usual pigmentation of the area The anus should be inspected by separating the buttocks to tense the

Fig 5 Exposure of anal ring in woman with a marital outlet Index finger within vagina presses downward thumb of same hand and fingers of other hand exert pressure laterally to evert anal ring Dilated hemorrhoidal vessels are present also fissure at 12 o clock

perianal skin The subject may then be asked to bear down to expose the anal ring The Sims position is convenient for this (Fig 3)

Palpation consists of inserting the gloved and lubricated finger into the rectum The examiner must note the tone of the anal sphincter, that is, its resistance to the entering finger and its constricting pressure upon the finger (This is important in certain neurologic diseases)

A convenient method of exposing the anal ring some of the anal mucosa and the inferior hemorrhoidal vessels in the female is as follows The patient lies upon her left side (if the examiner is right handed) with her knees well drawn up exposing the perineum The examiner stands behind the patient. He inserts the index finger of the right hand just inside the vagina and presses downward and backward with the finger The patient is asked to bear down and thus the anal ring may be everted If the tone is good assistance in the everting process may be given by the left hand using gauze (to prevent slipping) in stretching the tissues away from the anal opening This method may be used only with a marital vaginal outlet (Fig 5)

Special Instruments The anus and the rectum up to the level of the rectosigmoidal junction may be visualized A simple straight metal tube may be inserted through the anus and by reflected light with a head mirror the lower rectum may be inspected The instrument is gradually withdrawn the mucosa and hemorrhoidal vessels being inspected during the process Higher levels may be reached by the use of a light bearing tube—the sigmoidoscope

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17. THE GENITALIA, PERINEUM, ANUS, RECTUM—2

FINDINGS IN DISEASE

The Male Genitalia

Developmental Abnormalities Marked developmental deformities, such as absence of the penis, exstrophy of the bladder and the like, are rarely seen (Fig 1) Most of the congenital anomalies of the genitourinary tract may be easily understood in light of the embryologic background

The persistence of the infantile state of the genitalia, with a small penis and testicles and lack of pubic hair beyond puberty, may be a manifestation of endocrine disease (Fig 1 page 65) Conversely the precocious development of the genitalia and pubic hair may antedate the usual age of puberty owing to disease in the endocrine system (Fig 18 page 74) (The endocrinological implications were considered in Chapter 4)

Penis The most frequent developmental anomaly is a tight prepuce, preventing its retraction over the glans (Fig 2 also Fig 43, page 97) This is called *phimosis* and may mold the glans into a more conical structure as was indicated in the foregoing chapter If a tight foreskin is retracted behind the corona and cannot again be brought forward, the term *paraphimosis* is applied This is found to occur most often if there is preputial swelling due to inflammation or stasic edema

Fig 1 Exstrophy of bladder

Fig 2 Phimosis of moderate degree (note constriction of glans as foreskin is retracted)

Another not unusual anomaly is the misplacement of the urethral meatus Instead of being at the tip of the glans penis, it may be on its inferior surface, not uncommonly being at the site where the missing frenum should be This is known as *hypospadias*, and may interfere seriously with fertility More rarely, the urethra may open farther back on the inferior surface of the penis even as far back as the junction of the skin of the penis with that of the scrotum (Figs

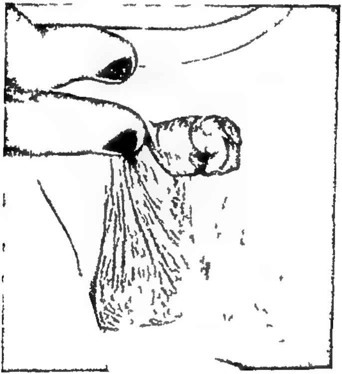

Fig 3 Hypospadias Urethral meatus is at usual site of frenum

3–5) Rarely the urethra opens on the dorsum of the penis *epispadias* (Fig 6) These congenital anomalies of the urethra are easily understood in terms of embryologic development At times the urinary meatus is small or is *stenotic* interfering with urination

Edema Noninflammatory swelling of the penile skin is commonly seen in conditions such as heart failure and in certain types of nephritis or nephroses (Fig 19, also Fig 13 page 259) The subcutaneous tissue of the skin of the penis contains much areolar tissue to permit the physiologic stretching in erection therefore fluid may

easily accumulate In dropsical states, the penis is often from 5 to 6 5 cm (2 to 2½ inches) in diameter, and the prepuce may be so edematous that retraction is impossible This thin stretched skin in edema appears to be almost translucent

Inflammatory Diseases Inflammation of infectious or noninfectious origin will be made manifest in changes of portions of the penis Phimosis leads to uncleanliness of the foreskin and glans The secre

Fig 4 Hypospadias Urethral meatus is at base of penis

tion from the sebaceous glands of the coronal sulcus especially occurring in increased amounts in the summertime may accumulate as a cheesy foul smelling material under the prepuce Because of the irritation and the resulting inflammation the delicate epithelium of the glans and lining of the prepuce may become denuded With secondary infection swelling and redness of the foreskin occur The inflammation of the prepuce just described or that due to some specific infectious process is spoken of as *balanitis* Ulceration of whatever nature of the glans and or prepuce may lead to such a state

Various types of infections may cause ulceration of the glans, the shaft of the penis, or inner surface of the prepuce Superficial, moist nontender ulcers developing from denudation of the epithelium of small papules are characteristic of *secondary syphilis* The firm, non tender, clean ulcer of the hard chancre or primary syphilis may be

Fig 5 Hypospadias Pseudovaginal opening (Patient shown in Fig 19 page 74)

found on the glans inner or outer aspect of the prepuce, or anywhere on the skin of the shaft of the penis (Fig 7) Similarly the excoriated dirty, painful easily irritated ulcer of chancroid (soft chancre) may have a similar location, though often it chooses to appear at the frenum on the under surface of the glans (Fig 8) The primary lesion of lymphopathia venereum is usually small and superficial

Fig 6 (Same patient as in Fig 1) Epispadias Urethral gutter on superior aspect of penis

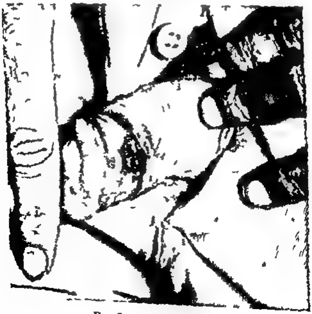

Fig 7 Syphilitic chancre

All three of these genital ulcers commonly have an associated lymphadenopathy of the inguinal nodes (Fig 9)

Herpes genitalis may be seen first in the stage of a small red papule or papules soon changing to several pinhead sized vesicles

Fig 8 Chancroidal ulcer involving much of glans Second ulcer is on penile shaft

(Fig 33) (These have the same general appearance as herpes labialis and cold sore [Fig 33 and 68 page 205]) The surface of these is easily broken leaving small superficial ulcers which become confluent On the glans inner aspect of the prepuce and especially in the coronal sulcus may be found at times especially in the uncleanly firm wartlike excrescences in varying numbers the *condyloma accuminatum* due probably to a viral infection (Fig 34) *Urethritis* of whatever cause will produce a reddened urethral meatus and a urethral discharge varying from a thin watery character to a thick purulent one

In the presence of infection, the main lymph channel along the inferior aspect of the penis may be indurated and palpable

Destructive inflammatory lesions notably chancroidal ulcers with or without secondary infection commonly leave deformities of the

Fig 9 Ulcer of lymphopathia venereum near frenum indicated by arrow Note large bilateral inguinal buboes shown by arrows

glans penis ranging from perforation or destruction of the frenum to partial loss of the glans (Fig 10) The spreading papuloulcerative process of *granuloma inguinale* is seen at times especially among Negroes of the southern states (Fig 11)

Occasionally skin diseases of the more generalized types may be made manifest by isolated lesions on the glans as in lichen planus or erythema multiforme (Fig 12)

Fig 10 Phagedenic (destructive) ulceration

Fig 11 Granuloma inguinale at frenum

Fig 12 Erythema mult forme of glans penis

F g 13 Elephantias s as result of lymphopath a venereum . (Kampme er R H and Larsen R M Am J Syph Gonor & Ven D s 26 316 1942)

The skin of the shaft of the penis may be expected to take part at times in the picture of almost any disease to which the integument is susceptible In addition to the infections of venereal origin which may affect the penile skin as well as the glans and inner aspect of the prepuce, there are many others These include the erythemas, papules, vesicles, and pustules of a great variety of dermatologic

Fig 14 Hyperpigmentation and fissures in pellagra

disorders The commonest are herpes genitalis, infected hair follicles scabies and the extension of tinea cruris from the groin onto the penile shaft

The thickened coarse skin of elephantiasis due to long standing lymphopathia venereum is rarely seen (Fig 13), in the tropics elephantiasis resulting from filariasis is apparently not uncommon (Edema of the skin has been considered under the affections of the prepuce)

Pigmentation The normal pigmentation of the genital skin may be so intensified as to become almost black in Addison s disease and

also in pellagra (Fig 14) In the latter fissuring with weeping of serum may occur

Malignancy The hard chronic ulceration of *carcinoma* of the glans penis must be recognized for early surgical removal (Fig 15)

Fig 15 Carcinoma of glans penis

Fig 16 Priapism in leukemia

Priapism This is the condition of painful persistent erection of the penis due to thrombosis in the corpora cavernosa Occasionally this occurs following trauma the usual cause, however being leukemia (Fig 16) Deformity of the penile shaft with loss of volume

Fig 19 Edema of scrotum and penis in congestive cardiac failure

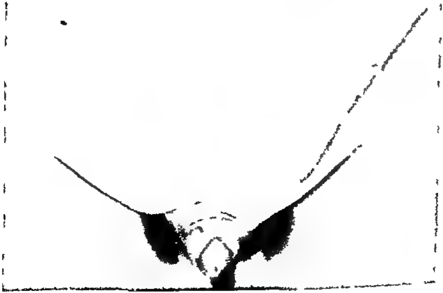

Fig 20 Cryptorchidism Testicles are in inguinal canals

Fig 21 Cryptorchidism Testicles in inguinal canals are accompanied by hernias

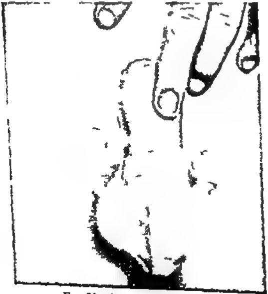

Fig 22 Undescended testicle

Scrotal Contents · *Testicles* One or both testicles may be congenitally missing from the scrotum, to remain in the pelvis or to be located and palpated as a tumor in the inguinal canal (Figs 20 21) The incompletely descended testicle will be found high in the scrotum and relatively fixed or immovable (Fig 22) An underdeveloped testicle is characteristic of infantilism A small, soft testicle indicates

Fig 23 Malignant tumor of right testicle

atrophy commonly following mumps orchitis other infectious orchitis or trauma

Acute *orchitis* (gonococcal or due to another organism) presents an enlarged very tender firm testicle with accompanying redness and heat of the overlying scrotal skin Cold inflammation that due to tuberculosis or gummatous syphilis causes testicular enlargement up to double the normal size from a firm to hard consistency unless

Fig 24 Epididymitis on left side

Fig 25 Varicocele (note mass of dilated veins above testicle)

necrotic softening has occurred The latter may be followed by draining sinuses Orchitis is usually secondary to epididymitis Malig nancy of the testicular tissues gives rise to a gradually enlarging hard and later often nodular, tumor even reaching the size of a clenched fist (Fig 23)

Fig 26 Hydrocele of right tunica vaginalis

The loss of the sickening *pain* produced upon squeezing the testicle occurs in diseases of the nervous system in which pain fibers are affected It is commonly lost or decreased in tabes dorsalis for example

Epididymis Acute epididymitis of gonorrheal or other infection presents a painful hot swelling or tumor posterior to the testicle (Fig 24) In tuberculous epididymitis a cold tumefaction appears

Varicocele is the term applied to varicosities developing in the pampiniform plexus The palpatory impression is commonly de scribed as that of feeling a mass of worms The varicocele is usually felt high in the scrotum applied to the spermatic cord as it approaches the external ring (Fig 25)

The tunica vaginalis may become distended by fluid as the result

of adjacent inflammation in the epididymis or, more commonly following trauma to the scrotum Such a *hydrocele* presents itself as a unilateral swelling of the scrotum varying from the size of a hen s egg to the size of the closed fist (Fig 26) Upon palpation it is firm because the fluid is under pressure in the sac The clear fluid of the common hydrocele transmits light readily as can be demonstrated by placing a lighted flashlight at the posterior surface

Fig 27 Congenital displacement of anus to posterior portion of vaginal opening

of the scrotum Bloody fluid (*hematocele*) due to injury or a solid tumor are difficult of differentiation from hydrocele at times but do not transmit light

Prostate As an aid in the examination of the genitalia rectal examination in the male may be most important Inflammation or congestion of the prostate gland is indicated by enlargement often with a loss of the median sulcus Its normal firm consistency is re placed by a bogginess In the *prostatic hypertrophy* of the elderly man the gland is enlarged and firm often with asymmetry A hard nodular prostate suggests the possibility of *carcinoma*

The *seminal vesicles* may be distended and very tender in *acute vesiculitis* of gonorrheal or other bacterial infection This exquisite tenderness is lacking in *tuberculous vesiculitis*

Cremasteric Reflex The absence of this reflex may be indicative of neurologic disease, causing a break in the reflex arc It may be lost in lesions localized in the upper lumbar segments of the spinal cord (page 38)

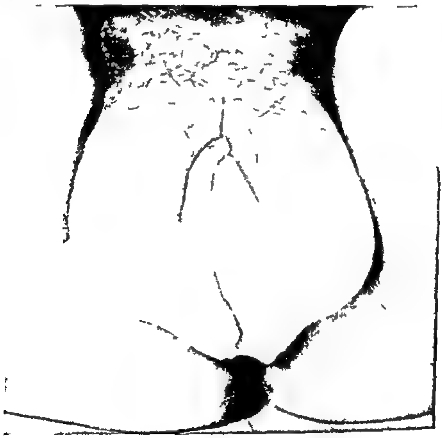

Fig 28 Edema of vulva in nephrosis

The Female Genitalia

Developmental Abnormalities Rarely will the physician see such unusual abnormalities as exstrophy of the bladder absence of portions of the genitalia or the rectum and the vagina forming a common cloaca (Fig 27) At times full development of the genitalia fails to take place (Fig 42)

The persistence of the infantile state of the vulva and the lack of pubic hair accompanied by absence of the menses beyond the years of puberty, indicate serious disturbance in the endocrine sphere In the earlier chapters, it was pointed out that the development of a

Fig 29 Elephantiasis of vulva as result of lymphopathia venereum (Kampmeier R H and Larsen R M Am J Syph Gonor & Ven Dis 26 316 1942)

masculine pattern of pubic hair accompanies certain endocrinological diseases

Labia Majora *Edema* Just as in the case of the male genitalia the loose tissue of the labia permits marked accumulation of fluid with intense swelling Thus in heart failure and in nephrotic dropsy

labial edema may be extreme (Fig 28) In contrast to this soft swelling there may be firm enlargement of the labium majus due to the induration and thickening of elephantiasis of lymphopathia venereum, filariasis, and other causes of lymphangitis and lymphatic obstruction (Fig 29)

Fig 30 Syphilitic chancre indicated by arrow

Inflammatory Diseases These are often of venereal origin though other processes of a nonspecific type also occur The external surface of the labia majora may be the site of the firm ulcer of primary syphilis (Fig 30) or of the tender, undermined ulcer containing a dirty exudate and bleeding easily, the ulcer of chancroidal infection Granuloma inguinale occurs as a papuloulcerative disease as in the male (Fig 31) The papules of secondary syphilis may be small and dry, or may be hypertrophic and moist the condyloma latum reaching the size of 1 or 2 cm (⅜ or ¾ inch) or more in diameter (Fig 32)

Just as in males herpes genitalis may occur first as a papule soon to be changed to a cluster of vesicles coalescing to a superficial moist ulcer The occurrence of the herpetic lesion is commonly associated with the menses and the resulting ulcer is usually attributed

to the chafing of the vulval pad (Fig 33) Infection of hair follicles is not uncommon especially associated with the irritation of the menstrual pad One of these may enlarge to become an actual furuncle The firm cauliflowerlike lesions of condyloma acuminatum so

Fig 31 Granuloma inguinale

commonly seen may be sparsely or profusely scattered over the labia (Fig 34)

The labial skin may be lusterless and of a pale pinkish cast because of epidermophytosis usually extending into the groin and onto the thigh as so called tinea cruris Such fungus infection is a common accompaniment of diabetes mellitus because sugar laden urine offers

Tumors of the Vulva Localized swelling of a labium majus may be due to infection of a Bartholin gland accompanied by redness and heat in acute infection Occasionally, a lipoma, fibroma, hemangioma, sebaceous cyst, or Bartholin gland cyst is the cause of a localized noninflammatory tumor (Figs 35, 36) These vary in consistency

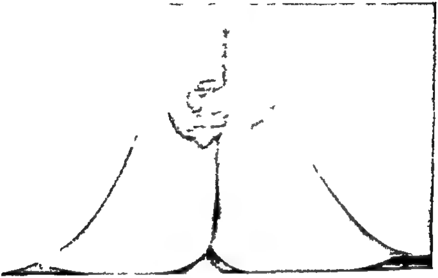

Fig 35 Hemangioma of labium majus

Fig 36 Fibromyoma of labium

from softness to rubbery firmness The chronic ulcer of epithelioma must be suspected for what it is so that it may be excised (Fig 37)

Labia Minora and Clitoris Upon separation of the labia majora, their inner surfaces are exposed as well as the labia minora and clitoris

Fig 37 Carcinoma of vulva (note edema of labia majora)

Edema The edema of the labia minora in heart failure or nephrosis may lead to great enlargement (Fig 28) Similar edema limited only to the labia minora may be due to contact sensitization as to rayon underwear to chemicals used in the manufacture of condoms and to those used as deodorants in menstrual pads (Fig 38) Just as the labia majora and clitoris may show indurated swelling in elephantiasis so the labia minora may take part in the same process (Fig 29)

Inflammatory Diseases The delicate soft labia minora often show inflammatory changes of diseases which do not affect the labia majora Inflammation of the labia minora may cause them to project beyond the labia majora In acute gonorrhea and other bacterial infections as well as in those of fungus origin the labia minora may be swollen and red, and feel doughy on palpation Likewise edema usually with less redness accompanies the multiple superficial ulcers or widespread mucosal erosion of secondary syphilis Single

Fig 38 Allergic edema of labia minora

Fig 39 Leukoplakia of vulva

or multiple firmer ulcers of primary syphilis may appear on the labia minora The elevated plaquelike condyloma latum of secondary syphilis may be found especially on the lateral surface of the labium minus (Fig 32)

Miscellaneous Diseases of the Labia Minora Upon separating the labia minora with the fingers, their inner aspects may be inspected or palpated In infection of a Bartholin gland the opening of the duct is

evident because of the redness about it A grayish white lusterless appearance of the inner labial surfaces indicates *leukoplakia* usually in the elderly woman and is at times the origin of the hard ulcer of carcinoma (Fig 39) Leukoplakia is to be distinguished from the atrophy and shrinkage of the tissues of the vaginal orifice in the elderly known as *kraurosis vulvae* Varicosities of the labia minora are found at times

Fig 40 Hypertrophy of clitoris—pseudohermaphroditism appearing in fifty year-old woman (beard also present)

The clitoris uncommonly shows anything of interest except at times phimosis of its prepuce and rarely unusual hypertrophy as part of elephantiasis or that of pseudohermaphroditism Hypertrophy may be evidence of profound endocrinologic disease and may accompany a tumor of the adrenal gland or of the ovary or from prolonged use of cortisone (Fig 40) In the uncleanly smegma accumulates about the clitoris (Fig 42) Otherwise the clitoris may show the lesions more commonly found on the labia minora

Disease of the Urethra Separation of the labia minora by the fingers also permits inspection of the urethral meatus If there is

Fig 41 Urethral caruncle Everted urethral mucosa appears as dark slit Rectocele bulges forward (Note senile atrophy of labia minora)

Fig 42 Infantile vagina Heavy deposit of smegma is visible between labia majora and minora and about clitoris

urethritis the meatus is reddened, and purulent secretion may be seen in it In the elderly or in those having borne children with some injury to the urethra the mucosa of the lower urethra may be everted to appear as a cherry red tumor up to the size of a pea, known as a *urethral caruncle* (Fig 41) Ulcers and other evidences of inflammation may at times be seen at the urethral meatus

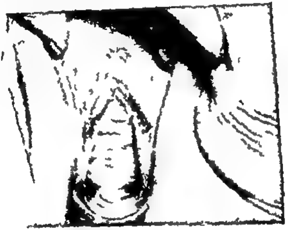

Fig 43 Cystocele Anterior vaginal wall bulges into lumen and toward introitus

Diseases of the Vagina and Its Introitus *Separation of the* labia permits the examination of the hymen If imperforate it may bulge and be bluish if the girl has reached menstrual age because of retained menstrual discharge This condition is known as *hematocolpos* A small or infantile vagina is met occasionally (Fig 42) So too absence of the vagina and other congenital anomalies may rarely be encountered

Ulcers of syphilitic or chancroidal origin are commonly found at the posterior fourchette A scar or widening at the posterior fourchette is evidence of a perineal tear at childbirth If the patient bears down the integrity of the vaginal walls can be tested In a multipara especially the vaginal walls may have been so stretched that upon increasing the intra abdominal pressure the bladder and/or rectum bulges into the vagina This forces the vaginal mucosa downward into the vaginal orifice these abnormalities are termed

cystocele and *rectocele* respectively (Figs 43, 41) With sagging of the whole pelvic floor and loss of uterine support because of repeated childbearing the uterus may sag so that the cervix is seen at the vaginal opening either constantly or upon straining This is spoken of as *prolapse* (Fig 44) Rarely the whole uterus may project, evert ing the vaginal mucosa with it known as *procidentia*

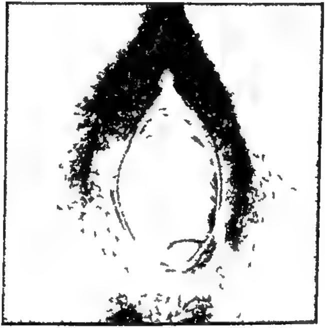

Fig 44 Prolapse of uterus Cervix is presenting at vaginal orifice

The presence of vaginal secretion or discharge is commonly made evident upon separation of the labia (In profuse amounts it may leak out from between the labia to be seen at first glance upon examination of the vulva before the labia majora are separated [Fig 48]) The discharge may be thick or watery foamy or creamy bloody or brown, and may be foul Vaginal discharge may be due to inflammatory processes of bacterial fungal or protozoan origin or due to new growth

With the bivalve speculum, the vaginal walls may be separated to expose the cervix uteri The os may be enlarged or patulous after childbirth, or it may appear as a slit due to tearing at such a time It may be everted and eroded, appearing red and raw, and lacking the

normal epithelial covering of the cervix With infection, there may be actual ulceration and inflammation of the cervix and its os Not infrequently small translucent cysts are to be seen on the cervix There are retention cysts of the nabothian follicles Occasionally benign polyps will be noted originating from the mucosa of the cervical canal Excavation or hypertrophy of the epithelium of the cervix suggests carcinoma

Fig 45 Imperforate anus (note anal dimple)

Slow withdrawal of the speculum permits inspection of the vaginal walls The normal pink color may be replaced by the redness of bacterial or fungus inflammation these are usually accompanied by mucopurulent secretion or exudate There may be the white curd like exudate due to thrush so often seen in the pregnant woman In the atrophic membrane of the aged woman the mucosa may be red with bleeding points and at times adhesions between the walls

As bimanual examination is carried out certain maneuvers may demonstrate abnormalities before the pelvic organs are examined The index finger may be inserted into the vagina and pressed against the urethra stripping it forward In the presence of urethritis, pus may be milked from the urethral meatus The two intravaginal fingers may be pressed down and backward to demonstrate the lack of support of the perineal floor such as may be lost through tears of the

perineal muscles at childbirth. Upon bimanual examination, the *fingers high in the vagina may note the irregular hardness of cervical* tumors or diagnose the presence of carcinoma or fibromyomas of the body of the uterus. Inflammatory lesions and tumors of the fallopian tubes and ovaries also may be demonstrated upon bimanual examination. Note should be made of their size, consistency, mobility, and tenderness. Bimanual examination may be of assistance in the recognition of tumors or inflammatory masses not originating in the

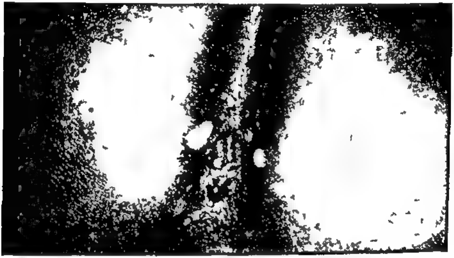

Fig 46 Perianal syphilitic condyloma latum (there are also dilated hemorrhoidal veins)

genital organs as in those arising from the sigmoid colon, the cecum, bladder, or sacrum.

Rectal examination in the female may assist in mapping out pelvic tumors or prolapsed pelvic organs.

The Anus and Rectum

Unrelated to the sex of the patient, examination of these structures may offer important findings in disease.

Inspection. Congenital anomalies are found at times. Of these, the imperforate anus is possibly the most common (Fig 45). Anovaginal developmental abnormalities occur occasionally. Inspection may reveal inflammatory lesions of the anal region, such as the ulcer of

the syphilitic chancre the condyloma latum and moist fissures of secondary syphilis (Figs 32 46) The wartlike condyloma acuminatum may be scattered about the anus as may be the more rare papules of granuloma inguinale (Figs 31 34) The dull grayish pink color of the perianal skin resulting from fungus infection is common Hyperpigmentation of the perianal area occurs at times in pellagra (Fig 47) and usually in Addison's disease as well as in other endocrinologic disturbances

Fig 47 Perianal hyperpigmentation in pellagra

Purulent or bloody discharge from the anus may be noted To one side or other of the anus may be a small opening draining fecal or purulent material—the *fistula in ano* leading to a *perirectal abscess* or to the rectum itself This usually remains as a result of a former perirectal abscess Such an abscess is readily recognized as a tender tumefaction to one side of the anus later the abscess usually ruptures and drains to form a sinus tract (Figs 48 49)

A tumefaction at some segment of the anal ring visible either without or upon partial eversion of the anus is usually a *thrombosed*

hemorrhoid (Fig 50) The clot shows through the vessel wall and overlying epithelium as a bluish tumor With absorption healing and scarring, a small epithelial, taglike projection may remain This is spoken of as a *hemorrhoidal tag* (Fig 50) Eversion of the anus

Fig 48 Fistula in ano indicated by arrow (note creamy vaginal discharge exuding from vulva)

may bring to light a whole series of dilated veins *hemorrhoids* of the external type This may also reveal an anal fissure a radial break or crack in the mucosa which is tender and bleeds easily (Fig 5 page 588) With severe hemorrhoids there may be a prolapse of the anal mucosa (Fig 51)

Fig 49 Perirectal abscess

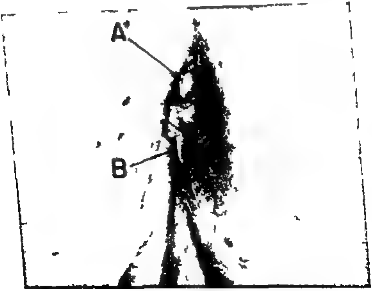

Fig 50 Hemorrhoids Thrombosed vein at *A* Hemorrhoidal tag at *B*

Palpation Insertion of the finger into the anus may reveal a lax sphincter This is encountered most often in neurologic disease as in tabes dorsalis or as the result of a third degree tear at childbirth or following an operation So also the tight or spastic sphincter due to adjacent inflammation or fissure will be obvious A stricture of

Fig 51 Prolapse of anal mucosa

the anus may result following hemorrhoidectomy or the repair of a third degree laceration The palpating finger may note the character and amount of fecal content The hard scybala of the dry dehydrated stool are characteristic (*Fecal impaction because of atony of the bowel in the aged or paralyzed patient is frequent*)

As the finger advances into the rectum it palpates for a stricture common in chronic lymphopathia venereum or the result less commonly of trauma or chemical injury The examiner also should note the consistency and fixation of any tumors encountered such as papilloma or carcinoma In the latter the degree of fixation of the rectal wall is of importance and should be recognized as evidence of extension of the process

High in the rectum the tip of the palpating finger may encounter the so-called *rectal shelf* This represents the edge of widespread carcinoma in the pelvis no matter what its origin

In acute appendicitis occasionally the tip of the appendix may hang in the pelvis Then digital rectal examination may be more helpful than abdominal examination in the diagnosis in demonstrating tenderness of the inflamed viscus

Inspection through Instruments By the use of the proctoscope and sigmoidoscope the examiner may see ulcers tumors, inflammations and strictures of the rectal mucosa The anal ring may be visualized and inspected for dilated hemorrhoidal veins and fissures

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systems Thus the examiner makes a rather composite or interrelated eries of observations

The author appreciates that the observations listed may not be so orderly and routine as in the examination of the chest heart or abdomen Thus examination of the skull and its abnormalities more logically falls into the chapters related to the head Likewise certain observations concerning the spine are more to the point at the time the chest is being examined since disease of the dorsal spine may be intimately associated with disease of the lungs

The time spent and care taken in detailed examination of the spine and extremities may vary greatly in different patients For example in the healthy person or in one with disease related to the gallbladder let us say who walks into the physician s office without manifestations of musculoskeletal disease the inspection of the spine and extremities may be very cursory By contrast in joint or bone disease or in disease of the nervous system it may be very detailed Furthermore some of the examinations of the musculoskeletal system cannot and should not be carried out in certain patients For example the physician should not think of evaluating the spine in the patient bedridden with pneumonia unless something unusual about the patient demanded it

POSTURE

Posture has been taken into consideration in other chapters as positions assumed in specific diseases of nonskeletal origin Here we wish to consider posture in the erect position and in walking as con cerned with the skeleton itself Posture in this sense has to do partic ularly with the spine pelvic girdle and the bones and muscles of the *extremities*

In the well developed person of good postural habits standing in the erect position as viewed from the side the following points will be noted relative to the musculoskeletal system The erect cervical spine keeps the head back as well as the chin up Thus the chin can not project forward beyond the vertical tangent of the chest The abdominal muscles are held taut so that the abdominal wall is at least flat Therefore good posture in silhouette will demonstrate a curve of the cervical spine the concavity being posterior The normal

18. MUSCULOSKELETAL SYSTEM AND EXTREMITIES—I

EXAMINATION OF THE NORMAL AND ITS VARIATIONS

IN EXAMINATION OF these structures the student and physician uses in the main inspection and palpation, rarely percussion In addition, manipulation of the spine joints, and muscles gives further information For special purposes, mensuration may be used for comparison as in for example differences between the two extremities The practices of modern medicine have come to depend more and more upon the use of the roentgen ray in evaluation of disease of the bones and joints Probably the radiologic technic has reached its greatest accuracy in this field since it is dealing with radiopaque structures Historically it is fitting that this should be so for the x ray in medicine was applied first to the study of bones

The inclusion of the spine and related structures in the chapter giving consideration to the extremities may seem out of place However the routine examination has progressed in orderly fashion as indicated in this book from the observations concerning the body as a whole to and through the examination of the genitalia The musculoskeletal structures remain for examination and since many diseases affect not only the bones and joints of the extremities but of the spine as well this chapter is all inclusive Examination of the extremities is not complete with observations made concerning the bones joints and muscles The examination of these cannot be divorced from an examination of the cutaneous vascular and nervous

height but not drawn back in the so called "military" position the arms hanging easily at the side. The iliac crests will be found to be at the same level. If the spinous processes of the vertebrae are marked with a skin pencil they will be seen to form a vertical line.

Fig 2 Normal woman (first pregnancy) There is accentuation of normal lumbar lordotic curve

In pregnancy certain changes occur which influence the normal or usual posture. During the latter part of pregnancy there is relaxation of the sacroiliac joints and the pubic symphysis. In addition the gravid uterus stretches the abdominal wall and acts as a downward and forward sagging weight. Owing to these several factors the pelvis is tipped forward enhancing or exaggerating the normal lordotic curve of the lumbar spine (Fig 2)

curve of the dorsal spine is such that the convexity is posterior The spine then curves forward again in the upper lumbar region to curve backward at the sacral level (Fig 1) A perpendicular line should

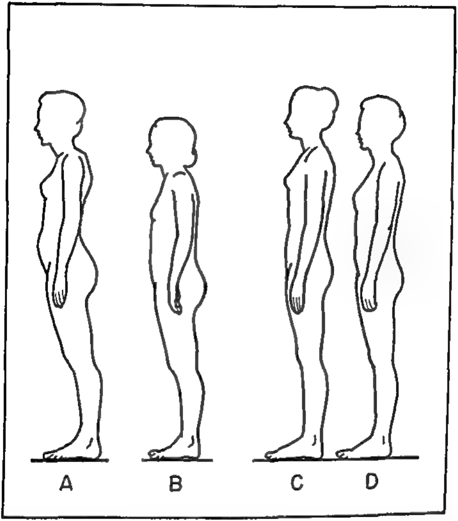

Fig 1 Photographic silhouettes *A* Demonstration of poor posture in hypo sthenic subject shoulders droop abdomen sags lumbar curve is increased and chin is far forward *B* Hypersthenic subject having fairly good posture spinal curves are lost Good posture in (*C*) hyposthenic subject and in (*D*) sthenic subject

pass through the lobe of the ear the shoulder, the trochanter of the femur the center of the knee and in front of the ankle

When viewed directly from the back the erect well developed person of good posture will present shoulders squared and of equal

head toward one shoulder and the other This may be done passively by the examiner as he grasps the head between his hands If the patient is examined in the erect standing position, he may be asked to bend forward to touch his toes as a test of the ability to flex the

Fig 4 Demonstration of mobility of spine in lateral flexion

spine (Fig 3) In the erect position he may bend backward to hyper extend the spine By bending his trunk to one side and the other the degree of lateral flexibility is determined (Fig 4) Rotation of the trunk on the pelvis tests the freedom of rotation of the spine as a whole In the absence of disease or certain changes that come with age these several exercises should be easily performed

Spine

The importance of the spine in maintaining correct posture has been implied in the foregoing paragraphs

Inspection Inspection of the spine is carried out, having in mind

Fig 3 Demonstration of mobility of spine in flexion

the curves and contours of the normal spine By inspection and palpation the alignment of the spinous processes is determined

The flexibility of the spine is tested by observation as the patient carries out certain instructions Freedom of movement of the cervical spine may be observed by asking the subject to tip his head backward and forward turning the head from side to side, and by tipping the

head toward one shoulder and the other This may be done passively by the examiner as he grasps the head between his hands If the patient is examined in the erect standing position he may be asked to bend forward to touch his toes as a test of the ability to flex the

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The same tests of mobility of the spine may be carried out as the patient sits on the examining table or in bed with his legs hanging over the side The examiner, standing behind the subject, may use his hands and passively move the spine by rotating the shoulders or by depressing one or the other to demonstrate lateral flexion, and similarly by pushing forward or by pulling back on the shoulders to obtain flexion or extension of the spine

From middle age onward, certain changes take place affecting the spine and thus posture Though they will be mentioned in their more extreme forms in the following chapter the student should think of changes occurring with age as being more or less physiologic and not actually pathologic, since they occur to some extent in the healthy normal, aging person

In an earlier chapter, it was pointed out that with the onset of middle age the chest becomes deeper and the ribs are rotated and are relatively fixed in an inspiratory position With the resultant over expansion of the lungs or emphysema, the normal dorsal curve or kyphosis becomes more exaggerated Thus the dorsal spine is definitely more convex posteriorly and the patient becomes round shouldered, the shoulders being placed more anteriorly as related to the spine With increasing age also the abdominal muscles become more relaxed especially if the increased subcutaneous fat of older age is excessive permitting the anterior brim of the pelvis to sag This downward tilt of the pelvis anteriorly naturally increases the normal lordotic lumbar curve There is also increasing relaxation of the ligaments of the spine All these factors thus lead to a definite change in posture in many older persons

Palpation Palpation of the spine may reveal bony abnormalities and tenderness The finger tips are used in feeling and *pressing upon* the spinous processes Tenderness of bony structures is of the deep type, usually demonstrated only by firm and somewhat persistent pressure Along with palpation of the spine the examiner should also include palpation of the paravertebral and other muscles related to the spine, such as the trapezius lumbar muscles etc Thus one searches for tenderness or spasm Continuation of this examination should also include palpation of the sacroiliac joints for tenderness or deformities

Sudden pressure may be applied to the vertebral column to produce pain in the following fashion The subject sits erect but relaxed with the legs hanging over the edge of the examining table Standing at the back the examiner clasps his hands over the vertex of the subject s head By a sudden pull downward, the vertebral bodies tend to be brought together in a telescoping type of movement A painful area may thus be localized in some instances

Fig 5 Technic for placing hamstring muscles under strain and for stretching sciatic nerve

Percussion Percussion may be applied to the vertebral processes either by the tips of the partially flexed fingers by the ulnar surface of the clenched fist or by a rubber percussion hammer In this way tenderness may be localized at times

Lumbosacral Region The lumbosacral joint region is often the site of disease and is an area to which many subjective complaints are referred Therefore examination of this portion of the spine is essential The mobility of this region and thereby proof of the absence of muscular spasm as well as intrinsic disease of bone or joint may be shown by the application of some of the tests applied to the spine As the patient stands erect he is asked to tilt his trunk to one side or the other (Fig 4) Standing with his knees *straight* the patient is instructed to attempt to touch the floor with his fingers (Fig 3)

Absence of sciatic nerve pain and spasm of the hamstring muscles may be shown by employing the following maneuver As the patient is seated, the examiner lifts the lower extremity with the knee extended Normally, the extremity may be lifted to the horizontal position, the thigh being at right angles to the trunk As the leg is supported in this position, the examiner can increase the tension upon the sciatic nerve by pressure upon the ball of the foot hyperflexing it upon the leg (Fig 5)

Extremities as a Whole

In the routine physical examinations, a heading is usually used for this subject matter Actually, the examination of a given extremity is really the study of its elements—the bones, muscles, joints, subcutaneous tissues, skin, and vascular and nervous systems

Commonly one compares the two upper and the two lower extremities with each other This comparison includes the contour, nutrition symmetry and development of the two members Note is made of their functional use, either upon active or passive movement Involuntary movements are almost certain to attract attention Attention is given to the mobility of joints The contour length, and size of the fingers and toes deserve notice because of their relationship to many constitutional conditions as was described in Chapter 3 The fingers may be spread and extended to bring out tremors

So too of exceeding importance is the state of the skin especially of the fingers and any observations which may be made concerning vasomotor activity The nails and nailbeds may show evidence not only of local disease but of systemic disease The nailbeds should be pink Though a point will be made in the next chapter regarding the curvature of nails in their long axis in disease states, it should be recorded here that moderate grades of such a deformity may be encountered in laborers as well as others

The radial artery as a convenient site for the estimation of the degree of arteriosclerosis and of the pulse rate has been considered in the chapter on the examination of the heart Absence of the pulse in the posterior tibial artery often is the first sign of arteriosclerosis obliterans The determination of pulsation in the dorsalis pedis artery

may be important under certain circumstances in which the blood supply to the foot is in question though it is said to be absent in about 8 percent of normal persons The color of both the upper and lower extremities should be noted in the dependent as well as in the elevated position Observations relative to the venous supply of the lower extremities must be made

Mensuration Actual measurements of portions of the musculo skeletal systems and extremities are at times worth while The length of the extremities and their relationship to the trunk may be important in the evaluation of endocrine disease as was indicated in Chapters 3 and 4 The orthopedic surgeon often uses mensuration in his work

At times it is necessary to measure the circumference of the two extremities at identical points for purposes of comparison This may be of help in diseases of the nervous or vascular systems since it may give clues to atrophy or to swelling

Bones of the Extremities

Those bones which are superficial enough to be inspected or palpated may be examined by these technics If there is occasion to examine the bones it is best done by comparing a bone with its fellow of the opposite side to note any deviation There may be moderate variations in the various bones between persons because of developmental differences There are also familial and sex differences in the size of bones In general those of women are smaller and lighter than those of men In some families the skeletal frame is larger and heavier than in others

By *inspection* one can readily compare the contour of the whole bone or some of its prominences with those of its fellow This applies especially to the clavicle scapula ulna patella tibia and bones of the fingers and toes

Palpation may be useful The examiner s fingers may feel the bone for changes in contour or shape or for swellings Firm pressure may be used to elicit tenderness The palpating fingers may note the temperature of the overlying skin *Percussion* applied by tapping the bone with finger tips or percussion hammer may be useful in locating tender areas

Joints of the Extremities

Examination of the joints involves actually the examination of the ends of the bones entering into the composition of the joint, as well as the *periarticular soft tissues, the ligaments,* tendons, and

Fig 6 Maneuver to test stability of left hip joint and strength *of gluteal muscles*

subcutaneous tissue Movement of the joint both active and passive, is an essential part of the examination

Inspection Inspection of a joint and comparison with its fellow concern its contour the presence or absence of swelling, the color of the skin over the joint and the position in which it is held Not

only should the position of the joint be noted but also how readily and how far the subject moves the joint

Palpation By palpation the examiner acquires more information concerning the bones making up the joint Furthermore, the examining fingers learn something about the periarticular tissues with regard to such points as swelling edema temperature changes of the overlying skin and whether there is tenderness upon pressure As the examiner s hands are clasped about a joint which is being actively moved vibrations may be felt (crepitus) These are also heard as snapping sounds at times Similarly, something may be learned concerning the tone of muscles adjacent to the joint

Fig 7 Maneuver to demonstrate floating patella

The examiner may find it worth while to test the mobility of the joint under study by passive movements Here the examiner supports one portion of the extremity so that its muscles are relaxed and then with the other hand moves the rest of the extremity (For example the observer may support the patient s forearm with the left hand and then with the right hand move the patient s hand in order to study the mobility of the wrist) By such passive motion the degree of mobility in extension and flexion, uninfluenced by the splinting action of muscles as in active movement of the joint may be determined

Stability of the hip joint or the strength of the gluteal muscles may be tested in the following manner In the standing position if the

subject is instructed to raise one leg by flexing the hip joint, the pelvis normally will be higher on the latter nonweight bearing side (Fig 6) The test is carried out on alternate sides for comparison of pelvic levels

In the case of the knee joint, a maneuver may be carried out to determine the presence of fluid in this large joint The patient lies recumbent The examiner firmly grasps the thigh with one hand just above the joint, and with the other grasps the leg in the region of the tibial tubercle Then by firmly pushing the hands toward each other any fluid present in the joint space is forced under pressure to distend the joint capsule somewhat The index finger of one of the examiner s hands then can be laid upon the patella, and quick ballottement like movement is made (Fig 7) If fluid is present in some amount, the patella rides anteriorly to the femur, and may be felt to strike the femur as it is balloted A patella which is displaced forward by fluid in the joint space is spoken of as a *floating patella*

Muscles

Though the muscles bulk large in the body in terms of volume and weight, comparatively little is learned about them upon *examination* Observations with respect to their tone and action more often than not reveal items of interest concerning their function and thus con stitute parts of the neurologic examination Involuntary muscular twitching though commonly of neurologic significance may be ob served at times in the fatigued muscle Most muscles are in tone to maintain posture *postural tone* as the result of many reflexes of the proprioceptive type

Inspection Inspection of the muscles consists of making observa tions of their bulk as a whole and a comparison of the volume of muscle groups on the two sides of the body In the normal, healthy person the muscles are usually symmetrically developed An excep tion is found in certain occupations (It was not unusual in the right handed blacksmith to find a much greater development of the muscles of the right arm and of the right shoulder girdle due to their excessive use in swinging a heavy hammer with one hand) The examiner should also look for local contractions of muscle groups

Palpation Palpation is used only to note the consistency of the muscle in the relaxed and in the contracted state and to determine the absence or presence of tenderness

Function The functional integrity of the neuromuscular unit is dependent upon *the function of the* central nervous system and therefore will be considered in the following section

NEUROLOGIC EXAMINATION

This examination is of the utmost importance Much of it can be and is most conveniently carried out along with the routine observations concerning the musculoskeletal system Some items those having to do with the sensory phenomena have already been indicated (Chapter 3 pages 60 62) The observations made regarding muscles with respect to muscular tone symmetry size and active and passive movements give clues to the state of the nervous system More specific tests should be carried out also

Muscular Coordination The constant tension of the skeletal muscles while the body is at rest is described as muscle tone Its function of course is to keep joints in the position needed to maintain posture Without tone the person seated or standing would be unable to remain erect Such tone usually means the proper balance between flexor and extensor muscles Any change in posture or station necessitates a change in the balance between antagonistic muscles

Maintenance of muscle tone is dependent in the main upon the spinal reflex arc This consists of afferent fibers entering the dorsal roots and influencing reflex arcs in the gray matter which in turn have their effect upon the efferent motor fibers Other reflex pathways also play a part in muscle tone The factor of balance in posture and station is provided by reflexes arising in the vestibular apparatus and mediated through the cerebellum The cerebral motor cortex also *plays its part in* tone as is proved by the fact that one can voluntarily change muscle tone and thereby one s posture (Muscle tone is also greater under mental tension or in excitement) This cerebral function is probably mediated through the centers of the basal ganglia important in the control of muscle tone as will appear in the next chapter

Several tests may be made which are of help in demonstrating disturbances in cerebellar function or in the reflex arcs in the spinal cord, which are so fundamental in the maintenance of muscle tone and coordination The *proprioceptive* or *deep sensations* are essential in muscular coordination These are the sensations of the position of muscles, joints, muscle tension, the direction of movement, and the like (pages 38 39)

Station and tests for it were described in Chapter 3 since it is related to gait an important facet in the general survey of the patient

Coordination in the upper extremities is determined by the finger to finger or finger to nose test (Chapter 3 page 61) The subject raises his arm to shoulder level extending it laterally, and then brings the hand in a sweeping gesture so that the tip of the index finger touches his nose This may be done alternating the two sides, with the eyes open and then closed Or the two hands may be swept around so that the tips of the two index fingers meet directly in front of the subject Normally these movements are carried out with little hesitation or deviation even with the eyes closed The *supination pronation* test also is a test of muscle coordination in the upper extremities The subject extends his arms in front of him and then rapidly pronates and supinates the forearms alternately Normally these movements are performed synchronously and are of equal amplitude The *rebound reflex* is tested for in the following manner The subject flexes the forearm on the arm at about a 45° angle He resists pull against the forearm on the part of the examiner As the latter suddenly releases this pull the normal subject s forearm makes a slight flexing movement and then stops evidence of normal coordination

In the *lower extremities* coordination may be tested by somewhat similar means Thus as the subject lies on the table with the eyes closed he is asked to place the heel of one foot on the knee of the other extremity and to move it slowly downward on the anterior border of the tibia to the foot The normal person does this without any unsteadiness

Motor Function In testing the functional activity of skeletal muscles one may hope to bring out evidence of disease through a comparison either of the strength or the use of like groups of muscles of the two sides Such testing is done by having the subject either

carry out active exercise or by noting his resistance to the examiner s actions

In testing by active exercise the strength of the deltoid muscles is shown by equal and unimpeded abduction of the arms Normal ac tion of the quadriceps muscles will permit the subject to squat and

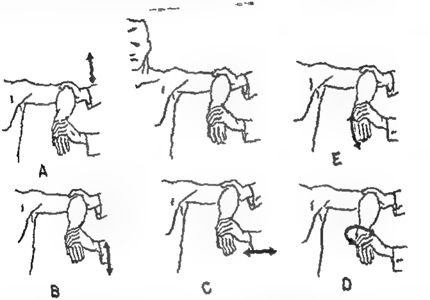

Fig 8 In the center is shown the subject s position which he is to maintain and in which he is to oppos for e applied by the examiner *A* In testing the abductors and adduction of the shoulder the examiner presses and then pulls up on the elbow *B* In testing the rotators of the shoulder he presses down and then lifts the hand and forearm *C* In testing the flexors and extensors of the elbow he pushes and then pulls on the hand *D* In testir the supinators and pronators of the forearm the examiner twists the hand clock wise then counter-clock wise *F* In testin flexors and extensors of the wrist he a tempts to flex and then extend the hand on the wrist (Courtesy of R A Utterback and J B Lippincott Co Am Pract & Digest Treat 7 413 1956)

arise from this position The dorsiflexors of the ankle permit the normal person to stand on his heels and normally functioning gas trocnemius muscles permit standing on tiptoes

By having the patient oppose force by the examiner muscle groups are easily tested The three divisions of the brachial plexus are tested by muscle group as by abducting the shoulder against pressure gripping the examiner s hand and by abducting the fingers against

the examiner s fingers Individual muscle groups can be tested by having the subject hold his shoulder and elbow joints at right angles against any opposing force made by the examiner The muscle groups so tested and method of testing are shown in Fig 8

The functional integrity of muscle groups of the lower extremities may be tested in a similar manner With the subject in the supine position, and with hips and knees flexed the patient resists efforts of the examiner as shown in Fig 9 The strength of the dorsiflexors of the ankles and toes may be tested in like manner

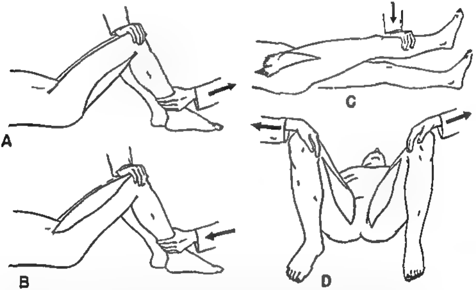

Fig 9 The ubject attempts to maintain the pos tion shown as the examiner applies force A B The hamstring muscles are tested as the examiner pulls and pushes on the ankle C To test the iliopsoas muscle the patient raises the ex tremity from the table one at a time as the examiner presses downward D The adductors of the thigh are tested as the subject resists pull by the examiner (Reference as in Fig 8)

Russell in emphasizing the need for testing muscle groups daily in the acute stage of anterior poliomyelitis describes similar testing of muscle groups which may be applied to the very ill bed ridden patient by the following instructions

For the upper extremities

Press your elbows down to your sides and hold them there (shoulder fixing muscles)

Pull your hands up to your face (biceps)

Push my hands away (triceps)

Squeeze my fingers hard (forearm muscles)
Spread all your fingers out and don t let me press them in (small muscles of hands)

For the lower extremities

Pull up your knee as much as possible (thigh and knee flexors)
Push your leg out straight (thigh and knee extensors)

Fig 10 Technic for demonstration of biceps tendon reflex

Press your leg down towards the bed (thigh extensors)
Pull your toes towards you (dorsiflexors)
Push down (plantar flexors)

Tendon Reflexes These represent examples of the stretch reflex The muscle must be under partial tension Then by a sharp tap of

a reflex hammer, the tendon suddenly is made to stretch the muscle, causing it to contract If the reflex contraction occurs, it indicates that the afferent and efferent portions are intact at the respective level for a particular reflex The degree or briskness of the muscular contraction is dependent upon muscle tone In old age and in marked

Fig 11 Technic for demonstration of triceps tendon reflex

malnutrition, this reflex may be diminished or absent probably because of the poor muscle tone Occasionally in the very obese the tendons may be buried under so much fat that the tendon cannot be struck adequately to procure a good response The reflex may be somewhat exaggerated in normal persons who are under emotional tension which may increase the muscle tone (pages 37 39)

The *biceps tendon reflex* is carried out by one of two methods For the subject in the erect position, the examiner supports the elbow with his hand the thumb lying on the biceps tendon the subject s arm lying upon the examiner s forearm The examiner s thumb is then struck by the reflex hammer (Fig 10) Normally the forearm

Fig 12 Technic for demonstration of Hoffman reflex (fingertip is to be snapped between examiner s thumb and index finger)

thereby is flexed on the arm For the subject in the recumbent position, the forearm held at right angles to the arm is laid against or across the trunk The examiner s thumb is placed as before and struck by the reflex hammer thereby flexion motion occurs This reflex arc is mediated in C5 and C6 *

The *triceps tendon reflex* is produced by having the upper extremity in either of the above positions and then striking the triceps tendon a quick blow with the hammer (Fig 11) Some degree of extension occurs This reflex is mediated at C7 and C8

* It is acceptable in medical litera ure to use the letters C D L and S as abbreviations for the cervical dorsal lumbar and sacral sections of the spinal cord The number designates segments of the respective sections

The *brachioradial reflex* (a periosteal reflex) is elicited by tapping over the lower third of the radius, which results in flexion and pro nation of the forearm, and flexion of the fingers and hand The reflex arc level is C5 and C6

The *Hoffman reflex* is a test of overactivity of the stretch or tendon reflex in the hand To perform this test, the distal phalanx of the index finger is snapped between the examiner s thumb and index

Fig 13 Hoffman reflex a pathologic response Thumb has flexed as fingertip is snapped

finger (Figs 12 13) A positive reaction is flexion of the terminal phalanx of the thumb

The *patellar reflex* or knee jerk is familiar to everyone The knee must be partially flexed The subject may hang his legs over the side of the table or bed or he may sit on a chair with both feet planted easily on the floor If lying in bed the subject s lower extremity must be passively raised and supported at the knee (Figs 14 15) Nor mally, in any of these positions if the patellar tendon is tapped there will be some extension of the leg This is mediated through the seg

ments of L3 and L4 One of the examiner s hands may lightly grasp the subject s thigh to feel the contraction of the quadriceps muscle if it is too weak to be seen * (It is essential that the blow applied to the tendon be direct and not glancing If the blow is upward toward the

Fig 14 Demonstration of patellar reflex (hand resting on thigh may feel contraction of quadriceps muscle even if it is too weak to be seen)

patella the knee jerk may be diminished if it is glancing and down ward it may accentuate the reaction)

* If either the patellar or tendo-achillis reflex is very weak or if the patient finds it difficult to cooperate and relax *reinforcement* may be tried The pa ient is instructed to partially flex his fingers to hook the fingers of one hand within those of the other and then to pull one hand against the other (Fig 16)

The *brachioradial reflex* (a periosteal reflex) is elicited by tapping over the lower third of the radius, which results in flexion and pronation of the forearm, and flexion of the fingers and hand The reflex arc level is C5 and C6

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the stretch to the gastrocnemius muscle When the subject is recumbent the knee is held partially flexed, and the extremity is everted Then the examiner pulls up on the ball of the foot while the tendon is being struck (Fig 18)

Fig 16 For demonstration of either patellar or tendoachillis reflex reinforcement may be necessary Subject locks his hands and pulls with each

Just as the prepatellar reflex is more easily applied to the bed ridden patient so too if there is hyperirritability of the tendoachillis reflex it may be demonstrated by a method differing from the above A blow may be directed to the ball of the partially everted foot Contraction of the gastrocnemius muscle is indicative of a hyperirritable tendoachillis reflex

A more convenient method of testing the quadriceps muscle reflex if the patient is bedridden is to test the suprapatellar reflex This is carried out by striking the upper border of the patella with a sharp blow If the excitability of the reflex is high this maneuver will cause contraction of the quadriceps muscle

Fig 15 In recumbent position examiner s hand must support knees to eliminate active flexion of knees

The *tendoachillis reflex* is obtained by striking the Achilles tendon above its attachment to the os calcis It must be under some tension to elicit the hyperextension phenomenon (*contraction of the gastroc nemius muscle*) (The arcs are in S1 and S2) The patient may sit in a chair with both feet planted easily on the floor When the tendon is struck and the gastrocnemius muscle contracts the heel may rise slightly from the floor Better yet, he may kneel on a chair with the feet hanging over the edge (Fig 17) The tendons may be struck in this position If the legs and feet are hanging over the side of the table or bed, the examiner may lift up on the ball of the foot to put some tension on the tendoachillis so that when struck it will transmit

ball of the foot he produces several times sudden movements flexing the foot on the leg The pressure on the foot must be sustained (Fig 20) (In certain diseases, a rhythmic muscular contraction

Fig ■ In recumbent position knee is partially flexed and everted Examiner tenses tendoachillis by pressure on ball of foot

Fig 19 Technic for inducing patellar clonus

of the gastrocnemius muscle is set up) Ankle clonus may be experienced in normal persons occasionally if the foot is held in such a manner that the gastrocnemius muscle is under persistent tension

A pathologic variation of the stretch reflex is *clonus* *Patellar clonus* is tested for while the patient is recumbent, the lower extremity being extended The examiner places his thumb and index finger at the superior margin of the patella and suddenly thrusts the patella toward the foot, then the tension is released somewhat This is done

Fig 17 Demonstration of tendoachillis reflex in kneeling position (note flatfeet)

one or several times (Fig 19) (In disease a rhythmic contraction of the quadriceps extensor muscle may be set up which may continue as long as the quadriceps muscle is kept stretched by the pressure of the examiner s fingers on the patella) *Ankle clonus* is tested for as follows The examiner with one hand supports the relaxed leg partially flexed on the thigh, with the other hand on the

ball of the foot he produces several times sudden movements flex ing the foot on the leg The pressure on the foot must be sustained (Fig 20) (In certain diseases a rhythmic muscular contraction

Fig 18 In recumbent position knee is partially flexed and averted Examiner tenses tendoachillis by pressure on ball of foot

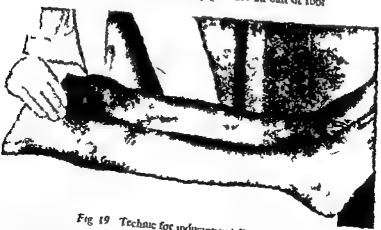

Fig 19 Technic for inducing patellar clonus

of the gastrocnemius muscle is set up) Ankle clonus may be experi enced in normal persons occasionally, if the foot is held in such a manner that the gastrocnemius muscle is under persistent tension

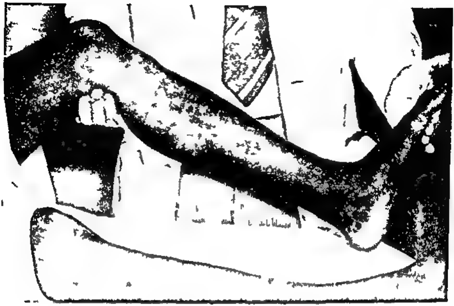

Fig 20 Technic for inducing ankle clonus

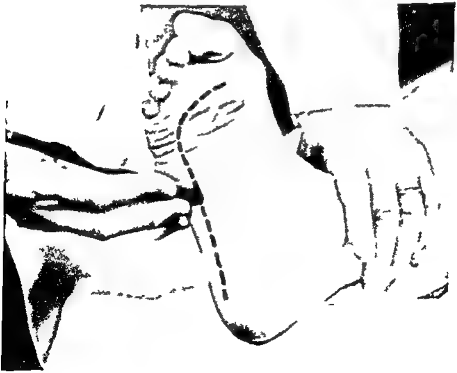

Fig 21 Normal response to plantar stimulation Toes react with flexion
Dotted line indicates path of the stroke

Superficial Reflexes The *plantar reflex* is performed by stroking the sole of the foot with a dull pointed object, a pencil or the like (Fig 21) The response normally is with flexion of the toes, as well as withdrawal of the extremity by flexion of the knee and hip (In the early months of life before myelinization of nerve fibers is complete, the plantar response is of the pathologic pattern, to be described in the next chapter pages 38 39)

Other tests in addition to the plantar reflex are used at times to elicit the pathologic extensor response (Babinski sign to be described in the next chapter) of the great toe In the *Oppenheim test* the examiner opposes the terminal phalanges of his thumb and index finger over the border or edge of the subject s tibia The fingers are pushed downward with firm pressure from at least in the upper third of the tibia well toward the ankle A positive response is dorsiflexion of the great toe The *Gordon test* consists of squeezing the calf muscles in an attempt to elicit the extensor response of the great toe The *Chaddock reflex* consists of extension of the great toe in response to stroking the foot around the lateral malleolus None of these equals the plantar reflex as a test for the extensor response

Sensory Tests There are several tests more specifically related to the extremities in addition to the evaluation of pain touch, and thermal sensation tests which may be applied to any area of the body and which were described in Chapter 3 (pages 60 62 [see pages 37 39])

Deep Pain Sense Firm and prolonged pressure upon a muscle causes deep pain The same may be demonstrated for tendons pinching the tendoachilis is a test commonly used for this

Position Sense In testing this response the subject must have the eyes covered so that he may not see the maneuvers to be carried out The examiner then grasps a toe between thumb and index finger and passively hyperflexes or hyperextends it (The toe must be grasped between fingers and not pushed from above or below which would provide a clue) Normally the patient can identify which toe is being manipulated as well as the direction of movement A normal interpretation of position is indicative of the integrity of the afferent impulses from muscles and joints transmitted by peripheral nerves to the dorsal column of the cord Obviously such maneuvers may be applied not only to the great toe but to any extremity or to any of its subdivi

sions as a test of the integrity of position sense or *proprioceptive sensation* This recognition of position and direction of movement permits coordinated movements

Vibratory Sense (Pallesthesia) A vibrating tuning fork (C 128) is applied over a bony prominence The normal subject should be able to recognize the vibration and the time of its cessation if it is stopped (The patient s eyes must be closed) Though vibration should be felt on the dorsum of the great toe, in the aged this may be lost, even though definite disease is not demonstrable Nevertheless normal limits should include the recognition of vibration at least as far distally as the malleoli For the perception of vibratory sensation the impulses must be transmitted from the skin and subcutaneous tissue to the dorsal columns of the spinal cord

Stereognosis The ability of the subject to identify an object placed in his hand and which he may move between his fingers, is a test of coordination and integration of sensory impressions and muscular movements It represents a test of cortical function

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19. MUSCULOSKELETAL SYSTEM AND EXTREMITIES—2

FINDINGS IN DISEASE

IN THE PRECEDING chapter the technic of examination of these structures was presented with some consideration being given to variations of the normal Furthermore it was pointed out that the roentgen ray examination was frequently of great aid in the adequate investigation of the bony and joint structures This should be reiterated in a chapter dealing with the abnormal Even though this is true the physical examination is nevertheless the fundamental consideration By this means the physician decides whether he is dealing with soft tissue disease usually clarified little by the x ray or whether there is a lesion of the skeletal structure which might be further studied by a special medium of examination This chapter therefore will deal with some of the abnormalities which may be encountered in the examination of the patient

Posture

Posture may be abnormally influenced by several factors—such as habit pulmonary disease abdominal disease spinal column disease disturbances in the nervous system and abnormalities of the extremities especially those of the lower extremities

Poor postural *habit* possibly should not be included in a chapter on disease but rather should be considered as a deviation from the normal However since it may lead in more pronounced instances to

symptoms, I feel it belongs here Bad postural habit usually dates its beginning to childhood The slouchy gait affected by some youths—that is, walking with shoulders drooped forward and chin carried anteriorly to the vertical plane of the thorax—all too often lays the

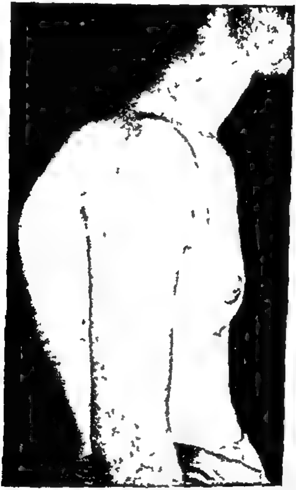

Fig 1 Kyphosis as result of poor posture in sixteen year-old girl

foundation for a permanently poor posture Such a person becomes round shouldered so that the shoulder joint is in a plane anterior to the vertical axis of the spine the dorsal curve is accentuated to an actual kyphosis and a flat chest usually develops (Fig 1) The slouchiness assumed by the child or youth while sitting at the school desk or elsewhere contributes its part to this postural trend In addition, such an attitude at the desk or table commonly leads to a

curvature (scoliosis) of the spine laterally, because one or the other elbow is used as a prop One or the other shoulder is lowered as a result of the scoliosis Factory work of a type which does not permit

Fig 2

Fig 3

Fig 2 Scoliosis compensating for herniation of nucleus *pulposus* with resultant *postural* abnormality

Fig 3 Lordosis as result of atrophy of shoulder girdle and spinal musculature in instance of progressive muscular dystrophy (*note* apparently normal calf *muscles*)

of an erect posture commonly leads to bad postural habits which may become permanent

In the last chapter we recalled from the chapter devoted to the chest that with the emphysema of older age the ribs are rotated up

ward, the chest becomes deeper, and the dorsal kyphosis is accentuated In hypertrophic emphysema of the lungs, the barrel chest this effect is seen at its best, at times resulting in a high degree of *dorsal kyphosis* (Fig 9, page 349) On the other hand, the markedly fibrosed

Fig 4

Fig 5

Fig 4 Lordosis and scoliosis in hereditary spinal ataxia

Fig 5 Postural change resulting from poliomyelitic paralysis of right lower extremity (pelvis is tilted permitting scoliosis)

lung with a resultant flat chest may decrease the normal dorsal curve Unilateral fibrosis and thickened pleura may be the cause of a lateral curvature or *scoliosis* through relative approximation of the ribs on the affected side, the concavity of the scoliosis being to that side

Abdominal disease as the cause of postural change is manifest usually as a weight producing a sagging of the abdominal wall and thereby accentuating the lumbar lordotic curve In the last chapter, it was shown that the normally pregnant uterus in the later months

Fig 6

Fig 7

Fig 6 Increased lordotic curve as result of obesity and relaxed abdominal wall (posture is relatively good)
Fig 7 Abnormal posture to counteract weight of fat apron

exerts such an effect In disease this effect is produced by ascites as in portal cirrhosis heart failure and pseudomucinous cystadenoma of the ovary by large ovarian cysts and other intra abdominal tumors

Both trauma and other disease of the vertebral column may affect posture (Fig 2) Arthritis of the spine with the attendant fixa

tion of the vertebral joints, tends to obliterate the normal spinal curves, and commonly leads to a vertical spinal axis that is perpendicular as it is viewed from the side This is especially true in the young It may not be true in those who have already developed the dorsal

Fig 8 Shortened right lower extremity due to congenital dislocation of hip *Front view* Note flattening of hip region *Rear view* Note raised right heel and deviation of intergluteal fold to left because of contraction of gluteal muscles

kyphosis of older years Destruction or collapse of one or more vertebral bodies will permit the elevation of the downward directed spinous process and thus, in the dorsal region increase the dorsal kyphotic curve and in the lumbar spine decrease the normal lordotic curve

Disease of the nervous system permitting changes in posture are on the whole the result of *muscular paralyses* Weak or paralyzed muscles of the shoulder girdle will permit the shoulders to drop thereby increasing the dorsal curve If such disease is unilateral scoliosis may also develop because of imbalance of the opposing

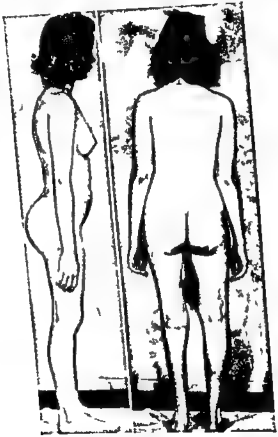

Fig 9 Postural changes as result of poliomyelitic paralysis of left lower extremity There are lordosis and scoliosis of spine

muscles Weakness or paralysis of the paravertebral muscles per: an increase in the lumbar curve—if unilateral scoliosis (Figs 3 Paralysis of muscles of one or the other lower extremity usually l to scoliosis because of the muscular imbalance for which the s must compensate (Fig 5)

are accompanied by *rigid splinting* or spasm of the paravertebral muscles, which is easily noted upon palpation. Firm palpation or percussion of the spinous process by finger, fist, or percussion ham

Fig 11 Gibbus as result of tuberculosis of spine

mer usually elicits sharply localized tenderness of the affected area

The muscle spasm of the paravertebral muscles splinting the under lying lesions mentioned in the several conditions above may be so intense as to fix the spine so far as movement is concerned and is commonly known as *lumbago*. The maneuvers described in the previ ous chapter designed to demonstrate mobility of the lumbosacral articulation and of the sacroiliac joints will be limited by muscle spasm if there is disease of these joints

Fig 12 Spina bifida with meningocele

Fig 13 Pilonidal sinus

Spina bifida is a congenital anomaly, a failure of fusion of the laminas of the spinous process This deformity is most common in the lumbosacral region A bulging soft tumor may indicate the defect

Fig 14 Absence of arm

as a herniation of the meninges, a *meningocele* (Fig 12) In the absence of such a tumor, a missing spinous process may lead the examiner to suspect *spina bifida occulta* which can be proved by x ray examination In the sacrococcygeal region a small soft to firm tumor may be found not uncommonly, the *pilonidal cyst* which is actually a dermoid cyst Some of these cysts are represented only as a residual sinus at the postanal dimple, draining the sebaceous content of a former cyst (Fig 13)

EXTREMITIES

Examination of an extremity may show the abnormalities due to some of the diseases described under bones joints, or muscles or their combination

Fig 15 Congenital enlargement of arm probably due ■ lymphangioma

In addition congenital abnormalities of a great variety may be met because of embryologic or developmental defects Thus a whole extremity may be missing or one or more segments may be absent (Fig 14) There may be differences in size as between the two upper or lower extremities An extremity may be of an abnormally great size owing to a congenital hemangioma or lymphangioma or of

unknown causes (Figs 15, 16) A number of congenital abnormalities of fingers and toes are seen at times The condition of supernumerary fingers or toes is termed *polydactylism* (Fig 17) Webbed fingers or toes show lack of separation of adjacent digits (Fig 18) When two digits are united, it is known as *syndactylism* (Fig 19)

Fig 16 Congenital enlargement of lower extremity because of neurofibromatosis (von Recklinghausen s disease)

In the generalized congenital abnormality of the mesenchymal structures of *Marfan s disease, the extremities* are long and show poor muscular development The weak ligamentous structures permit abnormal mobility of joints, as in hyperextension Arachnodactyly (spider fingers and toes) is part of the clinical picture (Fig 20)

Fig 17 Polydactylism (supernumerary thumb)

Fig 18 Webbed fingers

Fig 19 Syndactylism (left index and third finger)

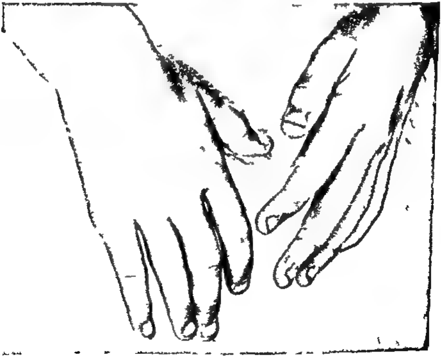

Fig 20 Arachnodactyly of Marfan s disease (see Fig 2 page 65)

In the examination of an extremity, not only does the observer note congenital anomalies and abnormalities of bones muscles, and joints as discussed above, but in addition he must be on the lookout for changes in the skin especially those related to the circulation Skin diseases have been discussed from a broad viewpoint in Chapter 4

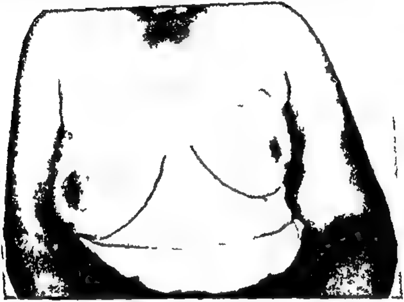

Fig. 21 Edema of left arm as result of metastatic carcinoma of breast involving axillary lymph nodes

Here attention will be given to the skin and its appendages only as related to diseases other than those of purely dermatologic interest

It seems best to describe separately abnormalities found in the upper and lower extremities even though some of the pathologic conditions to be mentioned are common to both

UPPER EXTREMITIES

Impairment of Lymph or Venous Flow Acquired enlargement or swelling of one arm is almost certain to be due to an obstruction in the return circulation either venous or lymphatic The latter will most commonly be due to the removal of the axillary lymph nodes

as in radical amputation of the breast Less often, it will be seen in diseases of the axillary lymph nodes which interfere with the return lymph flow, as in Hodgkin s disease, for example, or in metastatic carcinoma (Fig 21) Swelling may also occur because of obstruction to the venous return from the arm, as in mediastinal disease, such as aortic aneurysm, or in disease of the mediastinal lymph nodes

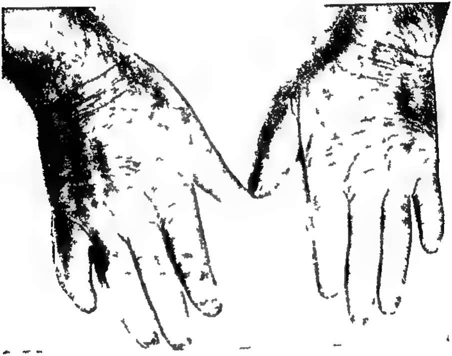

Fig 22 Raynaud s disease Note atrophic skin of distal phalanges

Rarely, thrombosis of the axillary vein is the cause of such an abnormality Under any of these circumstances the arm and hand will be swollen, and pitting edema may be marked in severe cases

Diseases of the Arteries These are uncommon The radial pulse may be reduced or absent if a cervical rib interferes with the flow through the subclavian artery Compression of the subclavian or innominate arteries by an aortic aneurysm also may affect the radial pulse Following trauma, an arteriovenous fistula or an aneurysm of one of the arteries in the arm may develop to be manifested by a pulsating tumor of varying size and presenting a palpable thrill and a

bruit Rarely small, tender nodules may be felt along the course of the brachial artery in the disease periarteritis nodosa

Vasomotor Disturbances In the hands, several manifestations of vasomotor disease may be found The psychoneurotic person, or one suffering from neurocirculatory asthenia has cold moist palms due to vasoconstriction in contrast to the patient with thyrotoxicosis, who has

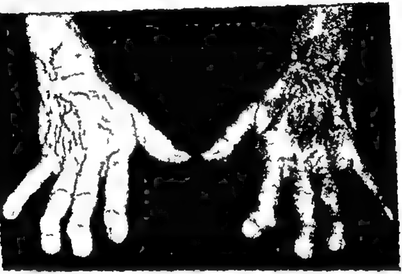

Fig 23 Rheumatoid arthritis showing subluxation of interphalangeal joints (Haygarth s nodosities) flexion of distal phalanges cutaneous atrophy and ulnar deviation of fingers

warm moist hands because of dilated capillaries to permit heat loss The former has a bluish mottling of the palmar skin The patient with rheumatoid arthritis has cold wet palms, the skin over the phalanges is atrophic being smooth thin and shiny This is due to some vasoconstriction and capillary stasis and is accompanied by lowered skin temperatures In Raynaud s disease, because of extreme vasoconstriction especially upon exposure to cold, the distal one or two phalanges of one or more fingers may be of cadaveric whiteness (Fig 22) If the vasospasm is maintained for a sufficient time gangrene of the dry type may supervene This may cause only a shriveled dry black spot or may be of such degree as to involve an entire distal phalanx In frostbite, for example persistent intense

Fig 24 Ganglion

Fig 25 Fibrosarcoma arising from tendon sheath

Fig 26 Contracture following infection of tendon sheath of fifth finger

Fig. 27 Long tapering fingers of eunuchoid person

vasoconstriction may be followed by gangrene from prolonged ischemia and from thrombosis in the smaller arteries (Fig 40) In infants, *erythredema polyneuropathy* (acrodynia) is manifest by dilated capillaries, leading to a bluish red swelling of hands and feet In all of these conditions associated with disturbances of the blood supply the autonomic nervous system is at fault, either through its abnormal stimulation or because of intrinsic disease

Fig 28 Stubby fingers and spadelike hand of acromegaly (see Fig 17 page 70)

Diseases of the Finger Joints Rheumatoid arthritis characteristically affects the joints of the hands The metacarpophalangeal and interphalangeal joints are enlarged, and show limited motion The joints are often subluxated or dislocated They are partially flexed except for the distal interphalangeal joints which may be hyperextended, because of muscular traction upon joints which have lost the integrity of the periarticular tissues The fingers and hand often show an ulnar deviation Thickened interphalangeal joints are spoken of as *Haygarth s nodosities* (Fig 23)

Diseases of Tendons and Tendon Sheaths Inspection of the tendons and tendon sheaths as they lie just under the skin on the dorsum of the hands may reveal lesions at times Rheumatic nodules are found not only about joints as will be mentioned under consideration of the joints With the light striking the hand at an oblique angle numbers of these nodules of millet seed size may be found at times along the tendon sheaths A *ganglion* is an isolated, rather

Fig 29 Clubbed fingers and watch-crystal nails (Hippocratic fingers)

firm nodule (0 5 to 2 cm in diameter) attached to one of the tendon sheaths from which it arises (Fig 24) It is filled with a jellylike substance and develops usually from a contusion of a tendon and its sheath Rarely solid tumors arising from tendon sheaths must be differentiated from a ganglion (Fig 25)

Infection or injury of tendon sheaths or of tendons commonly leaves residual contractures due to scarring (Fig 26)

Abnormalities of the Digits The configuration of the fingers is often characteristic of certain endocrinopathies For example the fingers of the eunuchoid person are long and tapering (Fig 27)

By contrast, those of the patient with acromegaly are short and stubby (Fig 28) As the patient extends his fingers, a *tremor* may be manifest in thyrotoxicosis general paresis, in chronic alcoholism and in other neurologic disorders Tender small nodules *Oslers nodes*, in the pulp of the finger tips may be encountered in bacterial endocarditis They represent emboli to the end arterioles

The finger tips may show enlargement of the distal phalanx, the *clubbed fingers*, also known as *pulmonary osteoarthropathy* of unknown cause (Fig 29) These are found in chronic suppuration of the lung, in certain types of congenital heart disease, in sickle cell anemia, and at times as a congenital anomaly without apparent cause Unilateral clubbing may accompany local vascular disease, such as aneurysm of the innominate artery

Fig 30 Spoon nails (koilonychia) in iron-deficiency anemia

The nail fold and cuticle may be inflamed and rolled inward the nails being lusterless a common condition characteristic of fungal infection A more acute inflammation may be due to pyogenic organisms Any inflammation of this type is known as *paronychia* Evidence of nail biting indicates 'nervousness —an observation of great interest in the psychologic or psychiatric evaluation of the patient The same holds for the deeply nicotine stained fingers of the heavy cigarette smoker

Fig 31 White bands in fingernails resulting from arsenical intoxication

Fig 32 Spontaneous amputations and other trophic disturbances in syringomyelia

The *fingernails and nailbeds* are worthy of examination in searching for, and in the diagnosis of, certain systemic diseases *Brittle nails,* a tendency of the nails to break easily occur in hypothyroidism In some instances of iron deficiency anemia the nails may show a concave curvature, the so called *spoon nails* (Fig 30) This also occurs as a congenital anomaly The nails may be *ridged* longitudinally in undernutrition or in longstanding chronic infections Severe febrile diseases of some duration, as typhoid fever, for example, may

Fig 33 Chancre of tularemia

interfere with the nutrition of the growing nail This period is marked by a *white transverse line* in the nail slowly moving outward with growth until it reaches the end A similar white band may develop in *arsenic poisoning* (Fig 31) As part of the clubbed finger and at times without clubbing the nail assumes a curvature longitudinally, as well as transversely forming a so called *watch crystal* nail (Fig 29) As was pointed out in the preceding chapter such nails do not always mean disease since rather marked incurvature of the nails may be seen in laborers at times The nailbed may show *splinter hemorrhages* diagnostic of embolism to small arterioles, they are seen at their best in subacute bacterial endocarditis Rarely in bacteremia especially meningococcic or staphylococcic there may develop thrombosis of end arterioles or capillaries of sufficient degree

to lead to gangrene This has been known to occur in thrombocytopenic purpura also

Trophic disturbances occur in certain diseases of the central nervous system notably in syringomyelia The skin becomes thick the nails may cease to grow and may drop off and ulcers may develop Because of the loss of the thermal sense burns accentuate these changes Spontaneous amputation of the finger tips may occur (Fig 32) A similar process may occur in leprosy

The fingers are commonly the site of injury Specific ulcers such as those of syphilis and tularemia must always be kept in mind (Fig 33)

Tetany results from increased irritability of the neuromuscular system associated with abnormal electrolyte metabolism Commonly

Fig 34 Hypocalcemic tetany—rigidity of fingers and adduction of thumbs

this occurs in the presence of hypocalcemia Carpopedal spasms are characteristic The fingers become rigid and the thumbs are adducted and covered by the fingers The palm of the hand is hollowed by the contraction (Fig 34)

LOWER EXTREMITIES

Impairment of Lymph or Venous Flow The most frequent cause of swelling in the lower extremities is that of the edema of heart failure Less frequently it is part of the generalized swelling of nephritis and of hypoproteinemia Obviously gravity assists in accentuating generalized edema in dependent parts (Fig 77 page 122)

Obstruction to the venous return may be due to anything which will either partially or completely occlude the iliac veins The uterus late in pregnancy, ascites if fluid is of some quantity, or tumors of the uterus, such as fibromyomas, or other tumors in the pelvis may be

Fig 35 Elephantiasis resulting from recurrent lymphangitis (note enlarged subinguinal lymph node on the left)

the factor In *phlebothrombosis* of the veins in the lower extremity, there is obviously obstruction to return venous flow and edema of the extremity usually occurs *Distension of the three pretibial veins* may be one of the early signs of phlebothrombosis (*Pratt s sign*)

Lymphatic block may be manifest in disease of the draining lymph nodes—the femoral, inguinal or deep iliac nodes Lymphoma

metastatic neoplasm, and chronic inflammation may be the diseases of the lymph nodes which may lead to edema of the lower extremity Diffuse *lymphangitis* of recurrent type in one or both extremities eventually may lead to obliteration of many lymph channels The

Fig 36 Varicose veins of legs right thigh and labia (note pigmentation of legs)

lymphatics also may be blocked by parasites as in filariasis In the event of either of these there may eventually develop chronic thickening or induration of the skin of one or both lower extremities and a variable degree of enlargement of one or both lower extremities a condition named *elephantiasis* (Fig 35)

Edema of hereditary but of unknown cause is known as "Milroy's edema"

Diseases of the Veins The most common disease of the vascular apparatus is that of *varicose veins* The veins are tortuous in their

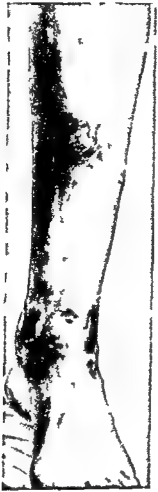

Fig 37 Varicose ulcers (note dilated veins and indurated skin)

course, and are dilated so that they are raised above the level of the skin They are found to be most prominent in the legs, especially on the posterior and medial aspects, and on the inner aspect of the thigh (Fig 36) Varicosities may not be visible while the patient is on the examining table or in bed The upright position either brings them out or accentuates them as gravity assists in their overdistention

Commonly they follow thrombosis of deeper vessels as in phlebo thrombosis or thrombophlebitis representing the collateral venous route In many they represent a congenital or familial weakness of the walls and valves of the veins

As part of the examination of varicose veins, it may be necessary to determine whether the valves of the veins are competent This can be readily demonstrated by the *Trendelenburg test* With the patient

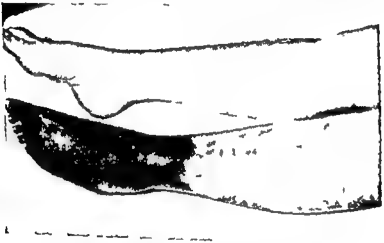

Fig 38 Gangrene as result of embolus to popliteal artery in patient having mitral stenosis and auricular fibrillation

in the recumbent position the lower extremity is raised to empty the veins The examiner occludes the upper end of the saphenous vein in the groin and maintains the digital pressure while the patient assumes the standing posture If the saphenous vein fills from above upon release of the pressure its valves are incompetent Then the whole maneuver is repeated the digital pressure upon the saphenous vein being maintained however If the vein now fills within thirty seconds it is evident that the valves of the communicating veins are incompetent (Normally the flow should be in the reverse direction in each instance)

The *tourniquet test* is carried out by applying a tourniquet high on the thigh below the fossa ovalis The patient then walks about If the size of the varicose veins below the tourniquet decreases it indi

cates that the valves of the communicating veins are competent This may be repeated with the tourniquet at a different level upon each occasion

Upon being bruised, varicosities tend to ooze blood subcutaneously becoming evident as black and blue spots The skin overlying varicosities is poorly nourished, and as a result thickening and pigmentation is common, the area having a reddish brown, leathery appearance

Fig 39 Aneurysm of femoral artery

(Fig 36) With mild trauma and hemorrhage in such areas chronic ulcers (*varicose ulcers*) tend to develop with ease because of the poor nutrition of the overlying skin (Fig 37)

Thrombophlebitis is accompanied by redness over the affected areas Upon palpation there will be found heat tenderness, and some swelling The thrombosed vein can usually be felt as a *solid* tender cord

Disease of the Arteries *Arteriosclerosis* of the vessels of the lower extremity in the elderly patient is demonstrated by a *palpable* and hardened dorsalis pedis artery accompanied by diminished pulsation Obliterative vascular disease involving arteries and veins of the legs especially, is known as *thromboangiitis obliterans* The involved extremity is cold and there is lessened or absent arterial pulsation

In the dependent position, the part becomes cyanotic, if elevated, white Vasospasm may be demonstrated by placing the extremity in cold water Because of vasospasm, the part becomes dead white After removal it may become very red indicating lability of the blood supply *Arterial* embolism is accompanied by a cold, white skin, a cadaveric appearance with absence of pulsation in the dorsalis pedis artery

Fig 40 Gangrene resulting from frostbite

If the arterial blood supply is cut off completely as the result of any of these conditions *gangrene* may develop It will be of the so-called dry type One or more toes may show a blackened area increasing in size The gangrene may extend to involve completely one or more toes which become shriveled and shrunken (Fig 38)

Aneurysms resulting from trauma are occasionally encountered in the lower extremities (Fig 39) Those arising from the popliteal artery in the popliteal space are probably the most frequent

Vasomotor Diseases The vasomotor manifestations of certain diseases mentioned under the discussion of the upper extremities apply to the lower extremities as well (Fig 40)

Fig 41 Scar over external malleolus from chronic ulceration of sickle cell anemia

Other Diseases of the Circulation Sickle cell anemia is especially prone to cause ulceration in the region of the malleoli, probably due to thrombosis following mild trauma Chronic ulceration at such a site in a Negro should suggest this diagnosis (Fig 41)

In persons spending much time sitting before an open fire there is chronic vasodilatation and in time pigmentation This appears as a marbled or mottled appearance of the skin over the anterior surface of the legs In the more active stage during the winter months a reddish hue is present Later on, brown pigment adds the dominant color, the red component being lost in the summer months This condition is known as *erythema ab igne* (Fig 4 page 155)

In so called *diabetic gangrene* due to poor blood supply and hyperglycemia infection easily occurs with slight trauma Beginning at the border of a toenail or in the callus on the ball of the foot there

Fig 42 Diabetic gangrene

will be noted a bluish discoloration then swelling and finally ulceration (Fig 42) This process often dissects deeply so that one may see tendons or periarticular tissues laid bare

Deformities of the Lower Extremities These are encountered in a number of diseases

Bowlegs are described as *genu varum* (Fig 43) and knock knees as *genu valgum* (Fig 44) Both may occur as the result of rickets osteomalacia osteogenesis imperfecta and achondroplasia They occur as the result of the weight of the body being borne upon abnormally soft bony structures Paralysis of muscles also may permit the development of such deformities The spasticity of muscles due to disease of the upper motor neuron may result in genu valgum since the adductors of the thigh are stronger than the abductors Because of the bowing of the long bones in *osteitis deformans* genu

varum is the result Anterior bowing of the tibia may be found to result from rickets congenital syphilis, and osteitis deformans In disease of the posterior columns of the spinal cord, a specific joint

Fig 43 Genu varum of Paget s disease

abnormality may develop Because of the loss of pain sense and proprioceptive reflexes as well as the accompanying atonicity of the musculature, repeated trauma of the knee and less often of the ankle leads to fragmentation of the ends of the long bones of these joints The knee or ankle is found to be enlarged irregular and nontender Due to stretching of the ligaments and joint capsule as well as muscular atony the joint can by manipulation be shown to have abnormal mobility in all directions As the patient supports himself on such a joint the leg may show unusual alignment (Fig 45)

Such a joint is known as the *Charcot joint*, and is found most often in tabes dorsalis, though it occurs also in other forms of neurologic disease

Fig 44 Genu valgum

The feet not uncommonly show deformities *Talipes* or clubfoot may be congenital in origin or due to neurologic disease In *talipes equinus* the patient walks on the anterior part of the foot or on his toes (Fig 46) *Talipes calcaneus* is the variety in which the patient walks on his heel the toes being raised *Talipes valgus* is a deformity in which he walks on the inner edge of the foot the sole being everted (Fig 47) whereas the *varus* type is that in which he walks on the outer border of the foot with the sole inverted (Fig 48)

Either the equinus or calcaneus variety may be combined with the varus or valgus type In *talipes cavus*, the plantar arch is exaggerated or heightened owing to contraction of the plantar fascia It may accompany the above anomalies

Hallux valgus is found in some persons owing to improper shoes this is a deformity in which the toes are deviated laterally, the toes

Fig 45 Charcot joint in tabes dorsalis

often overriding each other (Fig 49) *Pes planus* (flat foot) either congenital or acquired is due to the loss of the longitudinal arch of the foot It is very common in the Negro (Fig 17 page 654) In *hammer toe* the distal phalanx of a toe is flexed at a right angle (Fig 50) The *bunion* is a deformity at the metatarsophalangeal joint of the great toe on the inner border of the foot resulting from ill fitting shoes It is due to the swelling of a bursa at this site with callosity of the overlying skin and the deviation of the great toe laterally (Fig 49)

In certain neurologic diseases associated with hypesthesia or anesthesia injury of the sole of the foot may be followed by a sluggish painless ulceration often so deep as to lay bare the periarticular structures These *perforating ulcers* (mal perforans) are found most often on the medial aspect of the great toe or on the plantar surface

Fig 46 Talipes equinus (plantar arch is exaggerated as in pes cavus)

at the site of the metatarsophalangeal joint the ball of the foot (Fig 51) They occur more often in tabes dorsalis than in other forms of neurologic disease

Abnormalities of the Digits What has been said about the abnormalities which may be encountered in the fingers may, in general be applied to those of the toes

Fig 47 Talipes valgus

Fig 48 Talipes varus

Diseases of the Skin Though dermatologic diseases were discussed in general terms in Chapter 4, attention may be directed to disturbances encountered more frequently or only in the lower

Fig 49 Hallux valgus bunion of first metatarsophalangeal joint callus between great and second toes

extremities The most common is *dermatophytosis* popularly known as athlete s foot It is characterized by lesions between the toes They consist of dead white macerated skin often with fissures Secondary infection is common The allergic reaction the trichophytid is a vesicle or bleb commonly found upon the soles *Calluses* are common over pressure points *Plantar warts* are tender flat areas of

Fig 50 Hammertoe (third toe of right foot)

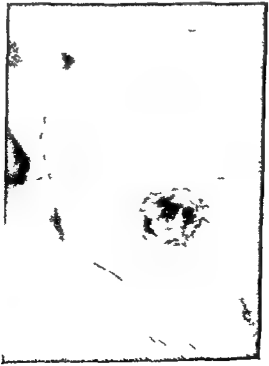

Fig 51 Perforating ulcer of tabes dorsalis

varying size over either the heel or the ball of the foot In areas of the southern states where hookworm is endemic, certain skin lesions should attract attention The portal of entry of the larvae is commonly on the feet especially between the toes Here there may be

Fig 52 Creeping eruption

maculopapules becoming vesicular and confluent—*ground itch* Persons living along the Gulf Coast may be subject to *creeping eruption* due to nematode larvae These migrate in the deeper layers of the skin for weeks or months (Fig 52)

Bones of the Extremities

Abnormalities in bone may be due to developmental nutritional inflammatory neoplastic traumatic or metabolic disorders

Developmental defects in bones are not encountered very often Occasionally there are malformations with deformity or even the lack of entire bones as a clavicle radius or the like

Osteogenesis imperfecta is a hereditary prenatal and postnatal defect in the activity of osteoblasts apparently causing brittle bone," which permits many fractures (Fig 53) *Achondroplasia* is also a hereditary developmental abnormality in which connective tissue from the periosteum invades the epiphyseal cartilages causing early union

Fig 50 Hammertoe (third toe of right foot)

Fig 51 Perforating ulcer of tabes dorsalis

in the early years of life In the presence of insufficient vitamin D, there is lessened calcium deposit in growing cartilage and in new bone The sharply delimited normal epiphyseal line found at x ray examina

Fig 54 Achondroplastic dwarfism Trunk is of normal proportion extremities are disproportionately short.

tion and indicative of normal calcium deposit at the ends of growing long bones is missing This line is widened less calcium is present and deformity results as the result of muscle tension With healing the bones may remain deformed in that thickening at times of a knobby type is present at the ends of long bones (Fig 55) This is a reaction similar to that resulting from the calcium deposit which

of the bones This leads to dwarfism—the *achondroplastic dwarf* characterized by a normal sized trunk and short extremities (Fig 54)

Fig 53 Osteogenesis imperfecta Deformity of thigh as result of fracture of femur

Nutritional deficiency as a cause of bony deformity or abnormality is not infrequent

Even the lay person knows of the ill effects of *rickets* a lack of vitamin D, upon the normal growth of bone in infancy and early childhood In the chapters devoted to the head and to the chest, note was taken of skull and chest abnormalities, respectively due to rickets

may occur as the result of hemorrhage at this site, and may lead to a tender swelling at the ends of long bones

The *inflammatory processes* in bone lead to quite clearcut changes found upon examination They may be seen at their best in a bone covered in part only by subcutaneous tissue and skin, as in the tibia

Fig 56 Rachitic bowing of bones of thighs and legs.

for example At many other sites the examination does not reveal the characteristic changes because they are masked by thick overlying layers of skeletal muscles Acute osteomyelitis due to pyogenic bacteria usually causes subjective sharp localization of pain and here the examiner will find early tenderness on pressure Shortly,

accompanies the healing of rickets at costochondral junctions leading to the rachitic rosary

Owing to the deficiency of calcium in the shafts of the long bones and in the flat bones of the pelvis deformities develop because of

Fig 55 Knobby deformities of distal ends of radius and ulna resulting from healed rickets

weight bearing Such deformities after healing last throughout life *The bowing of the femurs and tibias as the result of weight bearing* while walking in early childhood may be obvious (Fig 56) Such bowing may be laterally or anteriorly (In vitamin D deficiency in adults, the softening of bone is known as *osteomalacia*)

Scurvy is another deficiency disease which may lead to physical abnormalities in bone Accompanying the mucosal and cutaneous hemorrhages, there may be subperiosteal bleeding causing tender swelling over bones, especially found over the ribs and the tibias Some days later, the skin may be discolored by blood pigment In infants, pathologic fractures or dislocations of epiphyseal cartilages

may occur as the result of hemorrhage at this site, and may lead to a tender swelling at the ends of long bones

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swelling of the periosteum causes a tumefaction, as on the tibial surface, which is warm or hot and causes some edema and redness of the overlying skin In inflammation of fungus, tuberculous, or gummatous (syphilitic) origin, swelling with tenderness appears, but

Fig 57 Draining sinuses in osteomyelitis of pyogenic origin

the heat and redness are lacking (Many of these types of osteomyelitis may have reached the stage of drainage of the inflammatory exudate through sinuses by the time the patient is seen by the physician [Figs 57—59]) Percussion or tapping over an inflammatory area is accompanied by pain

In infants having congenital syphilis there may be a quite diffuse

inflammation of bones and joints The extremities are tender, causing pain upon manipulation There is swelling of the bones A forward bowing of the tibia (saber shin) may remain as a permanent residuum

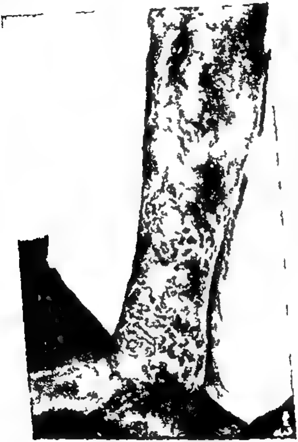

Fig 58 Late syphilis of skin and bone (note draining sinus of tibia in its upper portion)

Neoplasm of bone benign or malignant may appear in any portion of the skeletal system Osteomas or osteochondromas may cause localized hard or firm protuberances on bones and may be present for many years (Fig 60) More rapidly enlarging painful and tender tumefactions of bone may represent a sarcoma or other malignant tumor (Fig 61) These as well as the metastatic lesions of

hypernephroma or of carcinomatous origin, or those of multiple myeloma, may be manifest first as pathologic fractures—fractures occurring without extraordinary trauma—because of a loss of osseous integrity

Fig 59 Draining sinuses from tuberculous disease of phalanges (note clubbing of right fourth finger)

Trauma is a common cause of bone deformity The deformities immediately occurring with fracture may be quite obvious In routine physical examination, note will be made of abnormalities in the alignment of bones due to healing of fractures months or years before (Fig 62) Usually thickening of the bone is felt at the site of the previous fracture

Metabolic diseases are occasionally accompanied by diseases of the bony skeleton The best example of this is in hyperparathyroidism or so called *osteitis fibrosa cystica* in which the metabolism of calcium and phosphorus is abnormal with loss of calcium from bone With decalcification, spontaneous fractures may occur Disturbances of calcium metabolism may take place in severe thyrotoxicosis

F g 60 Deform t es of femur t b as and fibulas because of mult ple osteochondromas

F g 61 Sarcoma of rad us

resulting in decalcification of bone or the condition of *osteoporosis* Osteoporosis also occurs at times in pituitary basophilic adenoma It is common in women after the menopause, related to the loss of estrogenic hormone In senility, loss of adrenal hormones plays a

Fig 62 Deformity resulting from nonunion of fracture of humerus

part in osteoporosis Physically osteoporosis is made manifest by spontaneous fractures or fractures resulting from minor injuries

Polyostotic fibrous dysplasia described by Albright consists of a syndrome characterized by osteitis fibrosa disseminata areas of pigmentation and precocious puberty in females ' The pigmentation is described as having an irregular coast of Maine outline (Fig 63)

In xanthomatosis a disease of lipoid metabolism (*Hand Schuller*

Christian disease) in childhood tumors of the flat bones may be found

JOINTS OF THE EXTREMITIES

Joints may be deformed because of disease of the ends of the bones making up the joint Such deformities have been referred to above in the discussion of rickets scurvy, and trauma

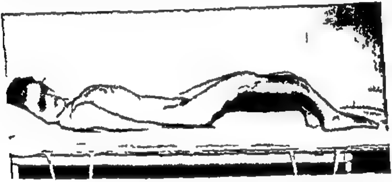

Fig 63 Polyostotic fibrous dysplasia with coast of Maine" pigmentation extending over buttocks and perineum

Mainly however the examination of joints is of interest in inflammatory conditions in degenerative processes and in trauma Less often the joints are of interest in allergic states and in metabolic diseases

Inflammation of joints is the cause of *arthritis* Either because of invasion of the joint itself by an infectious agent or through sensitivity to bacterial products or some as yet unknown sensitizing agent related to infection exudation into joint cavities and swelling of the periarticular structures occur Thus in acute rheumatic fever active rheumatoid arthritis gonococcal or other pyogenic types of arthritis there will be seen varying degrees of swelling of the joint (Fig 64) Other evidence of inflammation lies in the color which varies from pink to red The patient will be observed to hold the joint in a position permitting the greatest distention of the joint space Palpation will reveal warmth of the skin over the joint as well as some edema In these forms of arthritis palpation and passive manip

ulation will *demonstrate tenderness, varying from the mild to the* exquisite depending upon the acuteness of the process The range of motion will be limited because of the articular disease itself and accompanying muscle spasm Fluid may be demonstrated in disease of the knee joint by ballotment of the patella, as described in the preceding chapter (Fig 7, page 641) Some types of inflammatory arthritis

Fig 64 Swelling due to acute gonococcal arthritis of carpal and metacrapal joints

may be followed by partial or complete ankylosis or fixation of the joint

Tuberculosis of a joint differs from the above inflammatory arthritides *in presenting a less tender, white,* cold swelling (Fig 65) Syphilitic hydrarthrosis shows only fluid in a large joint with little if any tenderness

In rheumatic fever examination *may reveal additional findings* in the form of inflammatory rheumatic nodes in the subcutaneous tissue overlying inflamed joints or in the periosteum of adjacent bones Commonly their size is that of a kernel of rice at times larger If the light strikes the joint at the proper angle such nodules may be seen, especially if they are of the larger size (Fig 66) Large subcutaneous nodules may be found adjacent to joints in some cases of rheumatoid arthritis and in some instances of disseminated lupus

In the absence of joint disease movable painless subcutaneous nodules rarely may be found adjacent to one or more of the large joints of the extremities in treponemal diseases (syphilis and yaws) These are known as *juxta articular nodes*

Degenerative or *hypertrophic arthritis* (also traumatic) is of non inflammatory origin and thus on examination shows none of the characteristics noted in inflamed joints The joint of hypertrophic arthritis may be seen to be apparently somewhat larger than normal Palpation may demonstrate fluid at times In joints easily examined as those of the knees and ankles bony overgrowths occasionally may

Fig. 65 Knee joint distended with fluid as result of tuberculous arthritis

be felt along the joint margins As the joint is held between the examiner s hands and as it is actively moved, crepitus may be felt—a grating or scraping sensation Bony overgrowths of the terminal phalanges of the fingers occur in this disease and are known as *Heberden s nodes* (Fig 67)

Trauma such as a sprain of any joint or a dislocated semilunar cartilage of the knee joint is usually accompanied by swelling of the periarticular tissues fluid in the joint and by limited motion These

Fig 66 Rheumatic nodules at elbow

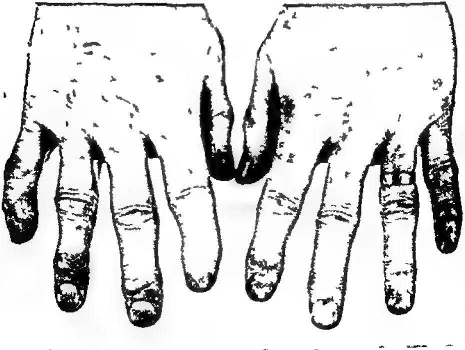

Fig 67 Heberden s nodes (note thickening of distal phalanges)

abnormalities are noted both by inspection and by palpation In persons suffering from hemophilia trauma may be followed by hemorrhage into a joint Upon healing it commonly leaves a fixed joint.

An *allergic* state may be manifest by exudation of fluid into a joint resulting in its distention, as well as in periarticular swelling so massive that the joint can hardly be moved This is seen at its best in serum sickness and in some instances of sensitivity to penicillin Such

Fig 68 Gouty arthritis of great toe

articular swelling may be a part of Schonlein s purpura here the joint fluid is hemorrhagic

In a disturbance of uric acid metabolism *gouty arthritis* may occur Small joints are more commonly involved though occasionally larger joints are affected also The most characteristic joint involvement is that of the metatarsophalangeal joint of the great toe This area and the great toe are seen to be dusky red in active disease Swelling is present Palpation shows heat of the area and extreme tenderness (Fig 68) Nodules containing urate crystals like tophi of the helix

of the ear, may be found about the small joints of the fingers if these are affected in gouty arthritis Less commonly, tophi appear at larger joints Rarely, sinuses form, draining the chalky material from the joints to the outside

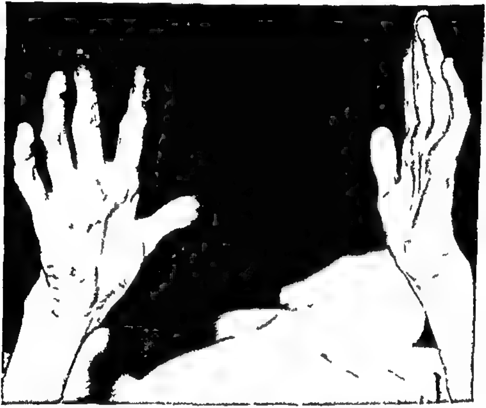

Fig 69 Progressive muscular atrophy Note wasting of intrinsic muscles of left hand—lessened fulness of palm and thenar and hypothenar regions

Abnormal mobility of joints as the result of decreased muscle tone or paralysis due to neurologic disease has been discussed Less com monly, it results from intrinsic abnormality of the ligamentous structures

Muscles

Some observations can be made regarding the skeletal muscles themselves in disease

Inspection In the general examination it was noted that general muscular wasting was evidence of undernutrition or starvation *Local*

ized muscular wasting is proof of either disuse or of disease of its nerve supply The leg or arm which has been in a cast because of a fracture shows muscular atrophy of disuse The muscles which are paralyzed because of central or peripheral neurologic disease are

Fig. 70 Amyotrophic lateral sclerosis as cause of wasting of intrinsic muscles of left hand

smaller (Figs 69 70) This is well seen in anterior poliomyelitis as an example of central nervous system disturbance (disease of the anterior horn cells) (Figs 5 9) The arm which has sustained an injury which has severed some of the peripheral nerves will show wasting of those muscles which have lost their nerve supply (Figs 71 72) The belly of a muscle may be deformed being smaller at one site because of the scar which follows the healing of a wound or a hematoma in the muscle following a contusion

The paravertebral muscles have been described as showing increased tone or spasticity to splint sites of vertebral diseases Similarly the muscles of the extremities may remain contracted to splint inflamed adjacent joints or diseased bone

Muscles may suddenly contract either singly or as a group This is called *myoclonus* and may be seen in epilepsy and in post

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Muscles may suddenly contract either singly or as a group This is called *myoclonus* and may be seen in epilepsy and in post

encephalitic states In disease of the anterior horn cells, as in progressive muscular atrophy, the observer may see irregular twitchings of groups of muscle fibers This is known as *fibrillation* or *fasciculation*

Fig 71 Brachial plexus paralysis Note atrophy of deltoid muscles (prominent bony landmarks) arm and forearm and characteristic deformity of hand because of paralysis of its intrinsic muscles

Such twitchings are observed most readily in the pectoral muscles in the deltoid, and in the muscles of the extremities

Palpation Palpation of muscles may reveal atrophy from either disuse or neurologic disease Such muscles are softer and less elastic than normal muscles Decreased muscle tone (flaccidity) is recognized as softness or flabbiness of the muscles upon palpation *Hypertonicity*

provides a muscle which is more tense or firm upon palpation Mus cular tenderness on palpation may occasionally be found In the acute myositis accompanying acute infections there may be tender

Fig 72 Volkmann s contracture

ness it also occurs in the perivascular inflammation of dermato myositis Tenderness may be exquisite in trichiniasis during the stage in which the parasite invades the muscle and also early in the stage of encystment Marked tenderness is commonly present in the pre paralytic stage of anterior poliomyelitis Scurvy too may be accom panied by tenderness of the muscles probably due to multiple small hemorrhages

encephalitic states In disease of the anterior horn cells, as in progressive muscular atrophy, the observer may see irregular twitchings of groups of muscle fibers This is known as *fibrillation or fasciculation*

Fig 71 Brachial plexus paralysis Note atrophy of deltoid muscles (prominent bony landmarks) arm and forearm and characteristic deformity of hand because of paralysis of its intrinsic muscles

Such twitchings are observed most readily in the pectoral muscles in the deltoid, and in the muscles of the extremities

Palpation Palpation of muscles may reveal atrophy from either disuse or neurologic disease Such muscles are softer and less elastic than normal muscles Decreased muscle tone (flaccidity) is recognized as softness or flabbiness of the muscles upon palpation Hypertonicity

NEUROLOGIC EXAMINATION

References have been made above to the effects of neurologic disease upon the muscles through their nerve supply Likewise certain effects upon joints, posture and the like have been indicated The application of the tests described in the preceding chapter are essential in the further evaluation of the nervous system

Muscular Coordination With loss of the cerebellar function in the coordination of the muscular activity in voluntary action or in interference with the reflex arcs in the spinal cord some of the following may be demonstrated

In *cerebellar disease* past pointing cannot be carried out the hand deviating to the one side or the other (pages 137 162) Nor can the pronation supination test be carried out because of inability of the muscles to be coordinated in such an alternating muscular activity A positive *rebound test* may appear the patient possibly striking himself as the arm is released (Nystagmus also occurs the extra ocular muscles being unable to maintain fixity of contraction (page 39)

In both disease of the *cerebellum* and of the *spinal cord* the following abnormalities may be shown in the first instance because of the loss of control of muscular coordination in the latter because of an interference with the spinal reflex arc and loss of postural sensation (proprioceptive sense) (pages 38 39)

As *station* is tested the patient may definitely sway and lose his balance completely This is the *Romberg sign* Upon walking with the eyes closed or with the eyes fixed upon the ceiling staggering is obvious

Ataxia or incoordination in performing finely controlled movements may be present in disease of either of the above types Under such circumstances the patient will be unable to carry out the finger to nose or heel to-knee test In milder grades of disturbance he may perform them but an abnormal amount of unsteadiness in carrying out the tests will be obvious When a subject with impairment of position sense attempts these tests with his eyes closed his performance is much worse On the other hand the patient having cerebellar disease shows the same difficulty with or without visual cues

Motor Function With disturbance in the function of the neuromuscular unit we move into the realm of disease in the nervous

The absence of *deep pain sense* in muscles or a tendon, such as the Achilles, indicates a break in the afferent impulses

In the rare disease of *myositis ossificans progressiva* bony hard nodules or ridges may be felt in the muscles (Fig 73) The cause of such ossifying inflammation is unknown

Fig 73 Myositis ossificans progressiva

Percussion Occasionally, the examiner will observe the phenomenon known as *myoedema* as he applies the method of immediate percussion to the chest As the pectoral muscle is tapped a localized contraction at this site may occur This is not uncommonly demonstrated upon tapping any of the skeletal muscles, especially in undernourished persons (At times it is seen in normal persons)

Tendon Reflexes The stretch reflexes may be either diminished or absent, or they may be increased or exaggerated* (pages 37 39)

In *diminution* or absence of these reflexes there is decreased muscle tone and impairment in the spinal cord reflex arcs There may

Fig 74 Progressive muscular atrophy Hand of uninvolved side is needed to raise glass

be disturbance in the afferent arcs as in the posterior column involvement of tabes dorsalis On the other hand if the efferent part of th arc is affected as in peripheral neuritis or in disease of the anteric horn cell (as in poliomyelitis) a similar effect is found

* The Hoffman reflex described on page 650 is evidence of overactivity of t stretch reflex

system, to be considered in the next section Passive movement of the limbs provides further information concerning the musculature and the neuromuscular unit (pages 37 39)

If the muscles are hypertonic, there is resistance to passive motion In spastic muscles, the resistance to the passive movement of a part may be of a constant degree, spoken of as lead pipe rigidity Or it may be irregular, of the so called *cogwheel' type* a little less tonicity being obvious at times in the resistance to passive motion

Flaccidity or decreased muscular tone permits abnormal movement of the part, and there is lessened resistance or none to passive motion The hypermobility of an extremity is especially demonstrable in hyperextensibility of joints For example, in tabes dorsalis (decreased tone being due to disease of the posterior columns and thereby loss of the proprioceptive reflexes) as the relaxed lower extremity of the recumbent *patient is lifted and supported* by the heel the knee may be seen to sag posteriorly

Paralysis of a muscle or group of muscles is usually obvious in disordered function, and points to specific neurologic involvement The paralysis or paresis may be central or peripheral In very recent *cerebral hemorrhage and involvement of the motor cortex* all the muscles of one side of the body may be paralyzed first being flaccid and later spastic On the other hand lead may have a relative specific toxicity for the radial nerve producing a neuritis manifested as wrist drop (*lead palsy*) due to the inability of the extensors of the wrist to act Disease of the anterior horn cells in the cord as in *poliomyelitis* or in progressive muscular atrophy also is made manifest by paralysis of muscles or groups of muscles (Fig 74)

Weakness or paralysis of muscles or more often muscle groups may be demonstrated by applying the maneuvers described in the fore going chapter for the testing of the integrity of the motor *nerve supply* to the muscles In like anatomic parts imbalance to resistance supplied by the examiner or by other means suggests motor weakness (Fig 75) Weakness of the gluteal muscles may be demonstrated by employing the standing and leg raising test as described in the preceding chapter As the patient stands on the *foot of the affected* side (the other leg and thigh being flexed) the pelvis will be tilted higher upon this side

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* The Hoffman reflex described on page 650 is evidence of overactivity of the stretch reflex

Pathologic *exaggeration* of the stretch reflexes occurs in instances of increased tone of the skeletal muscles This is shown at its best in spasticity of muscles, in which the inhibiting effect of the pyramidal tracts is decreased or lost Thus in disease of the motor cortex fol

Fig 75 Winged scapula as result of weakness of serratus magnus muscle demonstrated by pushing against wall

lowing cerebral hemorrhage (stroke) or in the congenitally spastic child, this abnormality is seen at its maximum Hyperactive reflexes also are characteristic of disease of the lateral columns of the spinal cord Multiple sclerosis and combined system disease of macrocytic anemia are two good and relatively common examples

Clonus is another manifestation of the exaggerated stretch reflex he technic for eliciting it was described in the preceding chapter ither patellar or ankle clonus may consist of only three or four ythmic contractions, or may be sustained almost indefinitely as

Fig. 76 Babinski sign—extension of great toe and fanning of remainder

long as the examiner maintains tension on either the quadriceps extensor or gastrocnemius muscles As many as twenty to thirty con ractions may be counted

Superficial Reflexes The *plantar reflex* may become abnormal in disease of the pyramidal tract whether of cerebral or spinal cord origin often accompanying exaggerated tendon reflexes An abnor mal response is manifest by a slow extension of the great toe at the metatarsophalangeal joint the *Babinski sign* or *extensor response* Often there is concomitant extension of the other four toes as well as abduction or fanning of these toes (Fig 76) (The test should be done with the lower extremity in extension otherwise it is not valid)

Other less-common methods used to demonstrate this pathologic reaction were described in the preceding chapter These are the Oppenheim Chaddock and Gordon tests (pages 38 39)

Sensory Tests In addition to the possible demonstration of abnormalities of pain, superficial and thermal sensations (Chapter 4), several sensory tests have their application particularly in the examination of the extremities (pages 37-40)

Position sense and *vibratory sense* may be impaired to a varying degree in disease of the peripheral nerves as well as in disease of the spinal cord In the former, neuritides of various types may prevent the afferent impulses from being carried to the cord In disease of the spinal cord in which there is impaired function of the posterior columns, there may likewise be shown a decrease or absence of position and vibratory senses Such abnormalities are encountered especially in the lower extremities and less often in the upper limbs

Astereognosis or the inability to recognize objects placed in the subject s hands, represents a lack of coordination of impressions reaching the cortex

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